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THE PROBLEM OF OUR SURPLUS SHEEP.*

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THE INCIDENCE OF THE PROBLEM.

After providing for total local consumption requirements, and allowing for losses due to deaths and other causes, our annual sheep surplus now amounts in round figures to 820,000. This position is the result of commendable enterprise on the part of our pastoralists and agriculturists, but in achieving it the relative proportion of sheep in the agricultural and pastoral districts has been entirely altered. Because of this, and accentuated by the collapse of the wool market, the matter demands serious and urgent attention lest the reward of enterprise turn to "Dead Sea Fruit."

TABLE I.

SHEEP IN AGRICULTURAL AND PASTORAL AREAS OF W.A.

1900–1930.

Year.	Agricultural Areas.*		Pastoral Areas.		Total for W.A.	
	Number of Sheep.	Increase + or Decrease. —	Number of Sheep.	Increase + or Decrease. —	Number of Sheep.	Increase + or Decrease. —
1900 ...	692,074	...	1,742,237	...	2,434,311	...
1901 ...	763,053	+ 70,979	1,862,802	+ 120,565	2,625,855	+ 191,544
1902 ...	775,494	+ 12,441	1,929,386	+ 66,584	2,704,880	+ 79,025
1903 ...	845,284	+ 69,790	1,755,349	— 174,037	2,600,633	— 104,247
1904 ...	1,022,414	+ 177,130	1,831,010	+ 75,661	2,853,424	+ 252,791
1905 ...	1,226,990	+ 204,576	1,893,713	+ 62,703	3,120,703	+ 267,279
1906 ...	1,386,799	+ 159,809	1,953,946	+ 60,233	3,340,745	+ 220,042
1907 ...	1,657,874	+ 271,075	2,027,100	+ 73,154	3,684,974	+ 344,229
1908 ...	1,867,346	+ 209,472	2,229,978	+ 202,878	4,097,324	+ 412,350
1909 ...	2,040,692	+ 173,346	2,691,045	+ 461,067	4,731,737	+ 634,413
1910 ...	2,243,452	+ 202,760	2,915,064	+ 224,019	5,158,516	+ 426,779
1911 ...	2,453,484	+ 210,032	2,958,058	+ 42,994	5,411,542	+ 253,026
1912 ...	2,230,020	— 223,464	2,366,938	— 571,120	4,596,958	— 814,584
1913 ...	2,120,313	— 109,717	2,301,062	— 65,876	4,421,375	— 175,583
1914 ...	2,076,894	— 43,419	2,379,292	+ 78,230	4,456,186	+ 34,811
1915 ...	2,181,077	— 104,183	2,622,773	+ 243,481	4,803,850	+ 347,664
1916 ...	2,480,764	+ 299,687	3,049,196	+ 426,423	5,529,960	+ 726,110
1917 ...	3,023,920	+ 543,156	3,360,271	+ 311,075	6,384,171	+ 854,231
1918 ...	3,622,574	+ 598,654	3,561,173	+ 200,902	7,183,747	+ 799,556
1919 ...	3,633,956	+ 11,382	3,063.995	— 497,178	6,697,951	— 485,796
1920 ...	3,625,797	— 8,159	2,907,168	— 156,827	6,532,965	— 164,986
1921 ...	3,501,032	— 124,765	3,005,145	+ 97,977	6,506,177	— 26,788
1922 ...	3,261,298	— 239,734	3,402,837	+ 397,692	6,664,135	+ 157,958
1923 ...	3,161,505	— 99,793	3,434,362	+ 31,525	6,595,867	— 68,268
1924 ...	3,517,964	+ 356,459	2,878,600	— 555,762	6,396,564	— 179,303
1925 ...	3,916,755	+ 398,791	2,945,045	+ 66,445	6,861,795	+ 465,231
1926 ...	4,246,325	+ 329,570	3,212,441	+ 267,396	7,458,766	+ 596,971
1927 ...	4,777,257	+ 530,932	3,670,223	+ 457,782	8,447,480	+ 988,714
1928 ...	4,828,546	+ 51,289	4,114,456	+ 444,233	8,943,002	+ 495,522
1929 ...	4,795,323	— 33,223	4,761,500	+ 647.044	9,556,823	+ 613,821
1930 ...	*4,899,497	+ 104,174	*4,971,503	+ 210,003	*9,871,000	+ 314,177

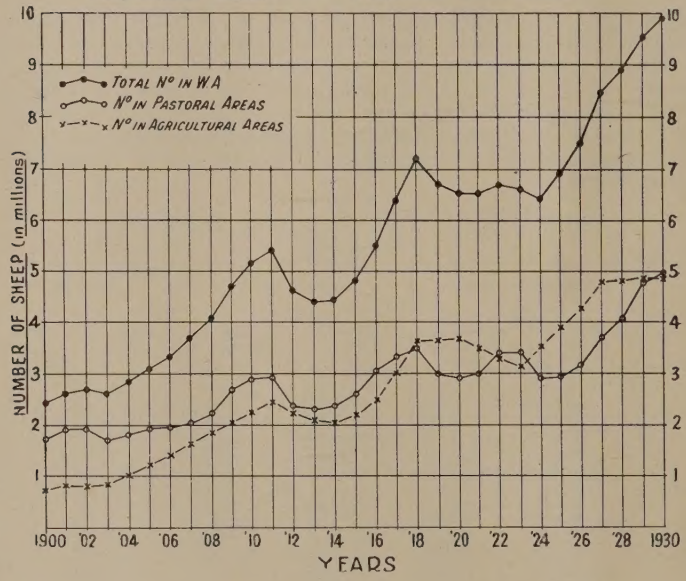
† South-West Division. * Preliminary figures.

* A Paper read before the W.A. Branch of the Economic Society of Australia and New Zealand on 31st July, 1931.

From Table 1 it will be seen that at the end of the last century there were 2½ times as many sheep in the pastoral areas as in the agricultural areas, the respective numbers being 1,742,237 and 692,074. In both areas the numbers continued to increase, but to a greater extent in the agricultural areas, for in 1918 the numbers of sheep in the agricultural and pastoral areas were approximately equal. Since then the development in each area has been along parallel lines, so that the relative positions have been maintained with similar aggregate increases until at the end of last year (1930) the total number of sheep in the State was approximately ten millions, with equal numbers in the pastoral and agricultural areas. It will thus be seen that in thirty years the sheep population has increased four times, that in the pastoral areas 2·8 times and in the agricultural areas seven times. The present relative positions and the changes that have taken place are graphically shown in Diagram A ; from this it will be seen that during

DIAGRAM "A."

GRAPH SHOWING SHEEP IN AGRICULTURAL AND PASTORAL AREAS OF WESTERN AUSTRALIA.


TOTAL N° IN W.A
N° IN PASTORAL AREAS
N° IN AGRICULTURAL AREAS
NUMBER OF SHEEP (in millions)
1 2 3 4 5 6 7 8 9 10
1900 '02 '04 '06 '08 '10 '12 '14 '16 '18 '20 '22 '24 '26 '28 1930
YEARS

the thirty years there have been three periods during which there have been rapid and unbroken increases in the numbers of the State flock. The first break in the continued progress occurred in 1911 and was due to unfavourable seasonal conditions in both areas. With a recovery from these the upward move recommenced and continued until the apex of the second period was reached in 1918, when the State sheep were approximately equally divided between the agricultura land pastoral areas. It is evident that temporary saturation had been reached, and that a similar position to that which now obtains had developed then. Further, there were indications that the time had passed when the extending development was keeping pace with the increasing surplus.

Those with an outlook broad enough to visualise the position established at Fremantle the works of the W.A. Meat Exports Co. With the establishment

of these works it was reasonable to expect that, under normal conditions, an expanding export within reasonable limits would cope with the decreasing capacity for development. That the time was ripe for the erection of these works was proved by the export, on their completion in 1922, of 25,456 lambs and of 13,115 in 1923. A buoyant wool market, and the discovery of the suitability of the East Murchison and Eastern Goldfields country for sheep, brought about an unforeseen condition of affairs, and the absorption of our surplus sheep by increased development. This provided an unexpected outlet for the surplus sheep and stopped the export.

Unsatisfactory as have been the results of the enterprise to the promoters of the W.A. Meat Exports Co., it is fortunate for the State at this time that these facilities exist.

TABLE II.

YEARLY ADDITIONS AND DEDUCTIONS OF SHEEP IN W.A.

1901–1929.

Year.	Number of Sheep in State.	Lambs marked.	Imports (live.)	Internal consumption.	Deaths.	Exports.	Annual State increase.
	thousands.	thousands.	thousands.	thousands.	thousands.	thousands.	thousands.
1901 ...	2,626	580	74	428	75	3	192
1902 ...	2,705	540	66	483	135	4	79
1903 ...	2,601	530	90	412	138	...	— 104
1904 ...	2,853	700	50	499	123	2	253
1905 ...	3,121	790	38	466	103	2	267
1906 ...	3,341	740	86	468	147	2	220
1907 ...	3,685	962	97	465	153	...	344
1908 ...	4,097	1,082	90	423	196	...	412
1909 ...	4,732	1,226	41	457	212	1	634
1910 ...	5,159	1,357	30	550	200	7	427
1911 ...	5,412	1,240	38	623	334	15	253
1912 ...	4,597	795	38	610	829	23	— 815
1913 ...	4,421	994	35	620	431	27	— 176
1914 ...	4,456	1,046	26	586	404	11	35
1915 ...	4,804	1,300	22	565	252	9	348
1916 ...	5,530	1,547	10	547	261	6	726
1917 ...	6,384	1,709	6	590	282	3	854
1918 ...	7,184	1,839	5	630	345	12	800
1919 ...	6,698	1,353	3	800	604	23	— 486
1920 ...	6,533	1,513	5	840	618	18	— 165
1921 ...	6,506	1,601	7	856	506	16	— 27
1922 ...	6,664	1,565	19	900	510	50	158
1923 ...	6,596	1,467	8	809	559	35	— 68
1924 ...	6,397	1,264	11	586	887	20	— 199
1925 ...	6,862	1,640	41	614	629	4	465
1926 ...	7,459	1,805	55	713	466	18	597
1927 ...	8,447	2,184	63	784	462	30	989
1928 ...	8,943	2,069	35	807	809	34	496
1929 ...	9,557	2,261	41	862	590	28	614
Averages...	5,461	1,300	39	620	388	14	246
Percentages	% 100	% 24	% 0·7	% 11	% 7	% 0·3	% 4·5

Table II. has been compiled from the records published by the Government Statistician, Mr. S. Bennett, with the object of obtaining average figures relating to natural increase and consumption requirements, deaths, etc., by ascertaining the different yearly additions to, and deductions from the State flock, the balance between which would be the increase or decrease for the year. It was found that this balance did not agree with the yearly increase or decrease in the sheep numbers. In most years the decreases were apparently under-estimated, but over the whole period the discrepancy amounted to less than $1\frac{1}{4}$ per cent.—a negligible amount. In view of the "extensive" methods which necessarily obtain in Western Australia, where "stragglers" etc., have to be estimated, such a close reconciliation of figures must be regarded as very satisfactory and a tribute to the methods of the Statistical Department.

From this Table it is learnt that the number of lambs marked amounts to 24 per cent. of the total sheep, and that the importations are comparatively small, amounting to 39,000 annually, or 0·7 per cent. There has been a decided increase in the consumption requirements, naturally in sympathy with the increase in our population. The deaths and other losses account for 7 per cent. There has been comparatively little export, and, though this has increased slightly in later years, it has averaged only 14,000 per year, or slightly more than a third of the average number imported. With scanty export it is obvious that the ever increasing surplus has been absorbed in our own State as the result of the greater development of older pastoral areas, the utilisation of new pastoral country on our Eastern Murchison and Eastern Goldfields country, and the adoption of sheep farming as an ally of wheat growing in the Wheat Belt as the pioneer holdings became developed sufficiently to carry sheep.

The increasing number of our natural increase each year brought the State nearer and nearer to the inevitable time when, despite development stimulated to the maximum, it would be impossible to absorb the whole. It is believed that that time is due or almost due, but, whether this belief is well founded or not, it has certainly arrived now as the result of the collapse of the wool market.

The collapse of the wool market has effectually prevented any additional development for wool on either old or new holdings in the pastoral areas, and in the agricultural districts, even where financial resources are not exhausted, any additional increase in the number of Merino sheep carried must be restricted to the absolute minimum necessary for the economical working of the farm.

A corollary to the cessation of development has been a serious disturbance of industrial conditions which has added tremendously to the unemployment difficulties, consequent upon the general financial stress existing throughout the Commonwealth.

The agriculturist can comparatively quickly adapt himself to the altered conditions by changing the character of his husbandry. The pastoralist, however, because of his geographical location, and the climatic conditions under which he works, cannot do so, and hence he will be the greater sufferer.

In the past the surplus in the pastoral areas has been disposed of—

(1) by exporting several thousands to British Malaya ;

(2) by supplying part of the needs of the Metropolitan markets, and

(3) by supplying the sheep necessary for the increased development, both in the pastoral and agricultural areas.

The market in British Malaya still remains.

The requirements of the Metropolitan mutton market have increased in sympathy with the increase in population. The latest returns show that the number of persons in the State as at 31st December, 1931, was 422,346 made up as follow :—

In pastoral areas	18,880
In agricultural areas	194,615
In metropolitan areas	208,851
Total	422,346

TABLE III.

CONSUMPTION OF MUTTON IN W.A.

PER HEAD OF POPULATION.

Year.	Population.	Carcases consumed.	Carcases per head.	Year.	Population.	Carcases consumed.	Carcases per head.
1901	194,109	428,234	2·21	1916	308,806	547,041	1·77
1902	213,327	482,877	2·27	1917	309,423	589,557	1·91
1903	226,954	412,484	1·81	1918	313,447	629,593	2·01
1904	242,289	499,331	2·06	1919	331,660	799,971	2·41
1905	254,779	466,002	1·83	1920	331,323	839,885	2·54
1906	261,746	468,418	1·79	1921	335,715	856,239	2·55
1907	263,846	465,114	1·77	1922	343,608	899,974	2·62
1908	270,823	423,056	1·56	1923	353,815	809,349	2·29
1909	276,743	457,098	1·65	1924	364,124	887,446	2·44
1910	276,832	549,977	1·99	1925	372,183	613,899	1·65
1911	286,584	622,555	2·17	1926	378,746	712,589	1·88
1912	301,362	610,214	2·03	1927	392,292	784,256	2·00
1913	320,684	619,975	1·93	1928	405,873	807,337	1·99
1914	324,195	585,528	1·81	1929	216,763	861,717	2·07
1915	318,016	564,535	1·78	1930	422,346	Not available.	

1901–29 Average consumption per head = 2·03 carcases.
= 93lb. weight.

Average weight Australian export carcase—

1927/28 = 44lb.; 1928/29 = 50lb.; 1929/30 = 44lb.
Average weight = 46lb.

From Table III. it will be seen that the rate per capita has remained fairly constant around about two carcases (av. 46lb.) per year. When compared with the rate of other countries this is extremely high, and it cannot be expected to increase. *The annual per capita consumption of mutton and lamb elsewhere is—United Kingdom, 26lb.; Canada, 6lb., and the United States of America, 5½lb. Though our population has more than doubled, the natural increase of our sheep has been at a considerably greater ratio, and is sufficient to provide for the requirements of over 3½ times the increased population.

Through the courtesy of the Chief Traffic Manager, W.A.G.R., it has been ascertained that the number of sheep transported over the railways to the Midland markets from the agricultural areas in 1930 was 539,813, and that from the pastoral areas, *i.e.*, from stations East of Mullewa and Southern Cross, was 59,310. In addition the Chief Inspector of Stock (Mr. A. L. McKenzie-Clark) advises that 66,337 were received by sea from North-West ports, making a total of 125,647. Using this number as being the share of the pastoral areas to meet the Metropolitan market requirements it will be seen from Table IV. that there are 654,000 surplus sheep in the pastoral areas, and, if the balance of the Metropolitan market requirements be supplied by the agricultural areas, the surplus in those areas will be 167,000, and in the State it will be 821,000. It is realised that some sheep are overlanded by road from the pastoral to the agricultural areas, and therefore, the figures used relatively for the pastoral and agricultural contributions to the Metropolitan requirements are not strictly correct; it is impossible, however, to ascertain what they really are and whatever they may be they will not alter the number of the State surplus.

* Commonwealth Year Book, 1930.

TABLE IV.

OUR SURPLUS SHEEP.

	Pastoral areas. (thousands.)	Agricultural areas. (thousands.)
Number of sheep	5,000	5,000
Lambs marked = 24 per cent.	1,200	1,200
Consumption in area (2 per head)	38	390
Balance	1,162	810
Deaths	350	350
	812	460
Export of Live Sheep ...	33	...
	779	460
To Metropolitan Markets by sea and rail	125	...
	654	460
Balance of Metropolitan Markets requirements ...	...	293
	654	167
	821	
Total Surplus =	821,000	

The pastoral areas will always supply some of the demand of the Metropolitan market for mutton, but now, with the increased numbers of sheep in the agricultural areas, and unless some new outlet can be found for their surplus, these areas will of necessity severely contest the right of the pastoral areas for that share of the Metropolitan market requirements which they have had in the past. In competition for this local market the advantage is likely to be with the agricultural areas because of lower freights, and, with an insufficient outlet for their surpluses, the competition must inevitably become so keen as to lower the prices below the costs of production with disastrous results to both pastoral and agricultural areas alike.

This development of an industry for which our State was admirably adapted, and was in great need, has been deliberately achieved as the result of a bold Governmental policy. It is recognised that the rate at which it has taken place has been a worthy achievement by our pastoralists and agriculturists, but the inability to dispose of the surplus sheep adds immensely to the almost impossible economic position of both the pastoralist and the agriculturist, consequent upon the collapse in wool values. As the State's prosperity is bound up with that of the sheep industry it is imperative to search for an outlet for the surplus sheep, and, as there is now no local one, the possibility of their export in some form demands consideration.

PROSPECTS OF THE EXPORT TRADE.

The Eastern States of Australia are much in the same position as Western Australia, and, in consequence, can provide no outlet for our surplus sheep ; on the contrary, if local prices increased sufficiently above their export parity to more than cover the costs of transport, sheep from the Eastern States would invade our local market.

For several years this State has exported live sheep to British Malaya. Table V., compiled from the Australian Statistics of Oversea Imports and Exports, shows

the number exported each year for the past five years, and from this table it will be seen that this market is practically the only one to which live sheep are exported ; the largest number exported in any one year was during the past year when 33,205 were sent away. Though this market is a limited one yet, because it affords an outlet for North-West sheep, it requires to be fostered to the maximum extent, and search made for others of a similar character.

EXPORTS OF LIVE SHEEP FROM W.A.

TABLE V.

Year.	To Malaya (British.)	Total.
1925–26	18,872	18,936
1926–27	30,403	30,403
1927–28	30,717	30,717
1928–29	28,102	28,154
1929–30	33,205	33,205
Grand Totals	141,299	141,415

From the figures in Table V. it is obvious that the export market for live sheep is extremely limited, and that the bulk of our surplus will require to be exported, if at all, in carcase form. Table VI., compiled from the same source as Table V., shows the principal countries to which Australian mutton has been exported during the past five years. From this table it will be seen that the principal market by far is that of the United Kingdom to which 82 per cent. of the exported mutton was sent in 1929–30. In this connection the Commonwealth Chief Veterinary Officer (Mr. R. P. Allen) advises : "The exports of mutton to Gibraltar, Malta and Egypt relate almost totally to the Mediterranean War Office contracts. The War Office does not buy lamb for these stations. Germany has closed her doors to the importation of frozen meat of all kinds, and France has a trade agreement with South America which is more favourable to that country than to Australia."

TABLE VI.

PRINCIPAL IMPORTING COUNTRIES OF AUSTRALIAN MUTTON.

(IN CENTALS.)

Country.	25/26.	26/27.	27/28.	28/29.	29/30.
United Kingdom	232,650	301,057	103,211	314,766	282,616
Canada	2,757	2,985	2,736	9,041	7,145
Ceylon	2,859	3,248	2,839	2,994	3,072
Hong Kong	4,228	3,134	3,353	2,727	1,918
Malaya	5,795	4,624	5,755	5,487	6,677
Gibraltar	1,716	338	1,282	2,177	1,121
Hawaii	597	212	152	348	243
Phillipines	577	670	528	779	460
United States	...	231	379	5,391	1,144
Malta	7,071	6,428	5,022	7,407	5,213
Belgium	...	...	4,784	6,731	20,925
Egypt	5,175	2,700	2,411	3,546	2,772
France	3,429	5,147	4,734	1,640	5,755
Germany	...	...	932	489	5,781

The relative volume of trade to the United Kingdom of Australia and her competitors, mainly New Zealand, Argentina and other South American countries from 1909 to 1930 may be seen from Table VII. The relation of the Australian

TABLE VII.

MUTTON IMPORTED INTO GREAT BRITAIN.

1909–1930.

Year.	Mutton exported from—			Total including small quantities from other sources.
	Australia.	New Zealand.	Argentina and other South American countries.	
				carcases.
1909	1,327,141	1,869,599	2,718,665	5,915,455
1910	2,723,148	1,991,115	2,838,714	7,552,977
1911	1,962,048	1,795,259	3,058,943	6,816,250
1912	1,643,790	2,315,453	2,717,363	6,676,606
1913	2,983,751	2,249,705	2,143,998	7,377,454
1914	2,088,222	2,616,650	2,041,929	6,746,801
1915	2,179,952	2,830,233	1,450,526	6,463,368
1916	270,959	2,410,126	1,453,767	4,192,298
1917	602,119	1,525,883	1,078,743	3,221,483
1918	23,506	1,188,787	1,230,127	2,442,804
1919	1,670,316	2,996,036	1,755,147	6,426,181
1920	3,035,650	4,043,006	1,563,214	8,650,209
1921	260,625	5,374,088	2,960,001	8,596,863
1922	910,003	2,983,619	2,137,608	6,031,230
1923	1,609,143	1,724,730	2,894,455	6,228,328
1924	212,228	1,984,165	2,746,216	5,077,698
1925	252,318	2,192,016	2,773,717	5,380,358
1926	489,526	2,393,370	2,657,887	5,605,290
1927	624,706	2,227,125	2,496,467	5,374,598
1928	566,324	2,100,174	2,407,663	5,077,084
1929	353,010	1,753,546	2,104,058	4,210,614
1930	726,519	2,557,326	1,904,604	5,188,449

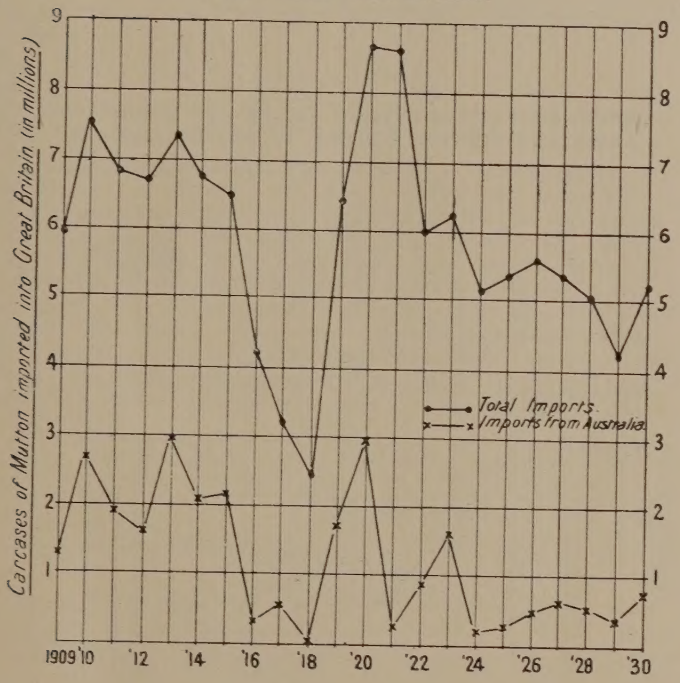
exports to the total exports is graphically shown in Diagram B, and from this it will be seen that the variations in the respective curves are remarkably sympathetic. Because of the varying geographical location of these countries it is unlikely that this sympathy is due to similar seasonal variations in each country. It is more than probable that it is due to prices ruling in the different years. Color is given to this opinion by the fact that the price for frozen mutton sometimes is so low as to be little, if anything, above the cost of treatment and transport. This was the case last year during the months of May, June, July and August, when the price obtained for Australian mutton varied from 3¼d to 3½d. per lb., and only during the first three months of the year did it exceed 5d. Messrs. Colebatch & Scott (Roseworthy Agricultural College) during an investigation into certain aspects of Fat Lamb Production on agricultural holdings estimated the expenses incurred in exporting lambs from Roseworthy College to London at 3d per. lb. Using this figure as representing the cost of treating and transporting mutton from Australia to the United Kingdom it will be seen that an export trade in mutton is only possible when comparatively high prices rule. Competition from South America is likely to be keener in this market than formerly, for, as advised by Mr. Allen " most of the mutton and lamb exported from South America in 1926, 1927, 1928

1929 and 1930 went to Germany and France. Last year, however, Germany prohibited imports of frozen meat, and the bulk now goes to France, who, by the way, have a trade treaty with South American countries in which the import duty on meat is all in favour of South America as compared with Australia."

DIAGRAM "B."

GRAPH SHOWING MUTTON IMPORTED INTO U.K., 1909-1930:

TOTAL AND AUSTRALIAN.


Carcases of Mutton imported into Great Britain (in millions)
Total Imports
Imports from Australia
1909 '10 '12 '14 '16 '18 '20 '22 '24 '26 '28 '30
1 2 3 4 5 6 7 8 9

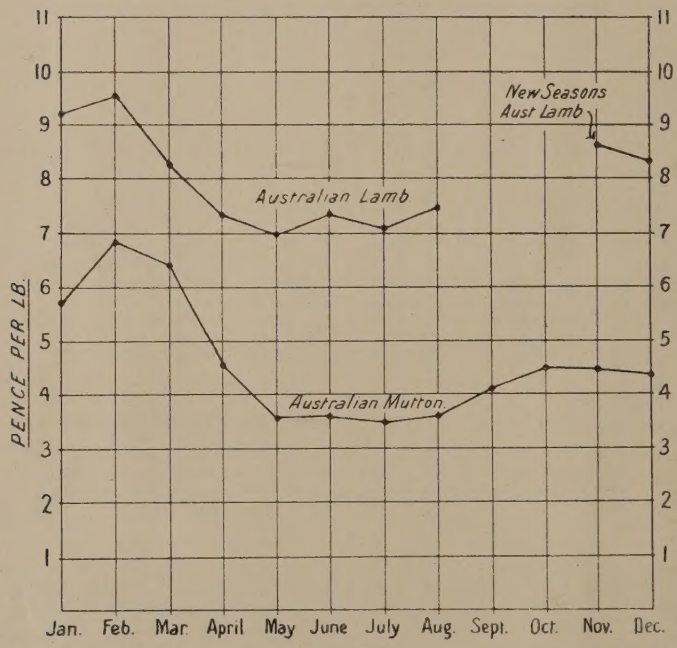
The outlook for frozen mutton is not promising, it is further complicated by the fact that the British market is closed to carcases of sheep which have been affected with caseous lymphadenitis. This trouble affects the lymphatic glands, and, where the gland is affected it is removed, and such carcases rejected for export to the United Kingdom. I am again indebted to the Chief Veterinary Officer, Commonwealth Department of Markets, for the information that in New South Wales and Victoria rejections for this cause have averaged about 35 per cent. in sheep three years old and upwards, and up to 20 per cent. in two-year old sheep and about 2 per cent. in lambs. Sufficient mutton has not been treated for export at the Fremantle Works to enable an definite idea as to the extent of the affection in this State. Even if it were much lower than in the Eastern States the disposal of the balance would still remain a serious problem.

It has been suggested that an outlet for some of our surplus mutton, and particularly the rejects, would be as canned meat. Mr. Allen, however, points out: "The possibilities of increased trade in this direction appear to be remote. The overseas demand has been found to be extremely limited. In fact it is likely that even five thousand cases dumped on the London market would dislocate the present trade. Whatever demand there is for canned meats appears to be confined to corned beef and this product is already slow of sale."

Fortunately, the outlook for the export of lamb is decidedly better. Diagram C has been prepared from data published by Messrs. Geo, Keen and Co., London, and from this it will be seen that the price of frozen lamb throughout the year is more than 3d per lb greater than that of mutton, *i.e.*, the extra price is more than sufficient to pay the cost of treatment and transport.

DIAGRAM "C."

GRAPH SHOWING MONTHLY PRICES OF AUSTRALIAN LAMB AND MUTTON RULING AT SMITHFIELD—1930.



In Table VIII. will be found the principal countries to which Australian lamb has been exported. Quoting Mr. Allen again: "America appeared to have possibilities, and in 1929 New Zealand exported fairly large quantities of lamb to America. In 1930, however, the United States of America imposed a duty of 5 cents per lb. on imported mutton and 7 cents per lb. on imported lamb, and this effectively stopped further importations of these classes of meat. Subsequently, a little business was done with Canada."

TABLE VIII.

PRINCIPAL IMPORTING COUNTRIES OF AUSTRALIAN LAMB.

(IN CENTALS.)

Country.	25/26.	26/27.	27/28.	28/29.	29/30.
United Kingdom	573,192	579,510	301,285	431,360	601,578
Canada	2,693	9,315	6,154	27,270	32,808
Ceylon	1,253	1,436	1,440	1,719	2,418
Hong Kong	1,785	1,260	1,460	1,869	1,577
Malaya	4,146	5,713	5,731	9,585	6,818
Gibraltar	...	...	...	...	...
Hawaii	3,566	3,696	4,846	4,811	4,715
Phillipines	963	684	1,134	1,308	1,159
United States	...	67	14	4,923	2,452
Malta	...	...	...	...	...
Belgium	...	...	...	...	2,288
Egypt	1,003	688	1,191	861	1,056
France	...	...	...	...	...
Germany	...	...	...	...	...

Ninety-two per cent. of the total Australian lamb exports were sent to the United Kingdom in 1929–30. Here again, as with mutton, the British market is the only one of any magnitude available for the Western Australian portion of the Australian surplus. The steadily increasing exports to this market from the competitors of Australia for this trade are shown in Table IX., and prove conclusively how valuable this market is regarded by them. Last year it was so abundantly supplied that its anticipated requirements were exceeded. In this connection Mr. Allen writes : " The greatest quantity of lamb that could be consumed in the United Kingdom is estimated at about twelve million carcases, and of mutton about five and a-half million carcases. Considering these figures were exceeded in 1930 if is a matter of wonderment where the surplus goes to."

TABLE IX.

Lambs Imported into Great Britain, 1909–1930.

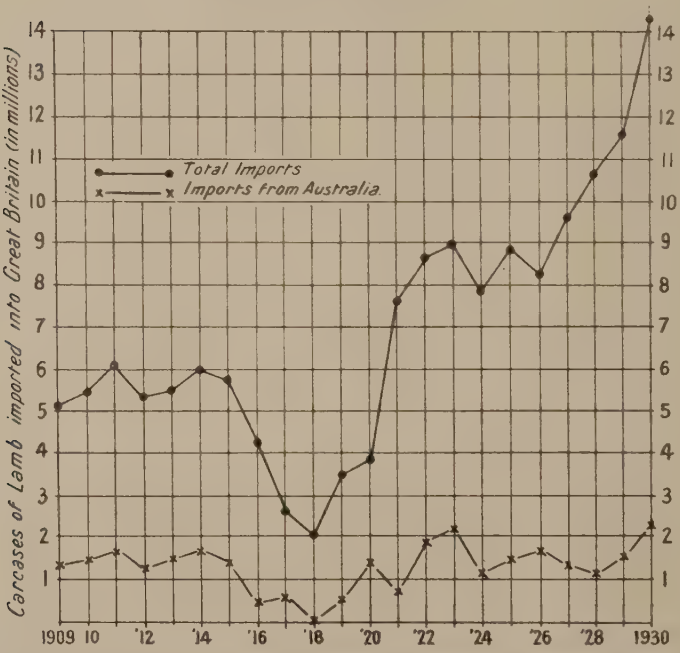
Year.	Lambs exported from—			Total, including small quantities from other sources.
	Australia.	New Zealand.	Argentina and other South American countries.	
				carcases.
1909	1,351,697	3,165,504	634,496	5,151,697
1910	1,496,660	3,416,359	515,048	5,428,067
1911	1,650,231	3,427,236	1,066,666	6,144,133
1912	1,239,689	3,179,838	913,032	5,332,559
1913	1,458,766	3,423,919	676,026	5,558,711
1914	1,634,608	3,564,534	842,896	6,142,038
1915	1,402,959	3,663,964	661,070	5,727,993
1916	400,929	2,997,096	857,684	4,280,438
1917	594,021	1,347,995	670,007	2,616,512
1918	15,072	1,641,925	370,980	2,028,052
1919	484,497	2,633,389	364,308	3,482,219
1920	1,441,224	1,927,663	468,008	3,836,920
1921	719,693	4,942,157	1,914,261	7,582,907
1922	1,843,049	4,792,452	1,958,668	8,594,169
1923	2,125,736	4,490,017	2,291,004	8,907,557
1924	1,180,860	4,624,564	2,079,968	7,904,385
1925	1,447,411	4,480,627	2,827,922	8,790,429
1926	1,679,995	4,721,045	1,866,801	2,280,841
1927	1,325,108	5,085,322	3,172,565	9,611,170
1928	1,176,090	5,782,565	3,697,867	10,685,682
1929	1,494,515	5,741,582	4,379,883	11,625,980
1930	2,220,582	7,146,146	4,911,670	14,278,398

From Diagram D, in which Australian lamb exports to the United Kingdom are compared with the total exports, it will be seen that, though there has been a slight increase in the Australian exports during the last three years, the total number exported from Australia last year was little greater than the exports seven years ago. It is obvious that Australia has not been utilising the advantages of the British market to the some extent as her competitors. Now, however, that Australia must seek some outlet for the surplus sheep this market must be exploited to the utmost.

DIAGRAM "D."

GRAPH SHOWING LAMB IMPORTS INTO U.K., 1909-1930:

TOTAL AND AUSTRALIAN.



It is disconcerting to find this market so abundantly supplied, but as it is our only market it is imperative that, whilst the prices are at all remunerative, its proper share be secured by Western Australia. In order to capture our share of this trade, fierce competition will require to be faced, and, to successfully overcome this, it will be necessary to study very carefully its requirements, and cater for them an almost meticulous extent.

THE PROBABLE UTILISATION OF THE EXPORT POSSIBILITIES.

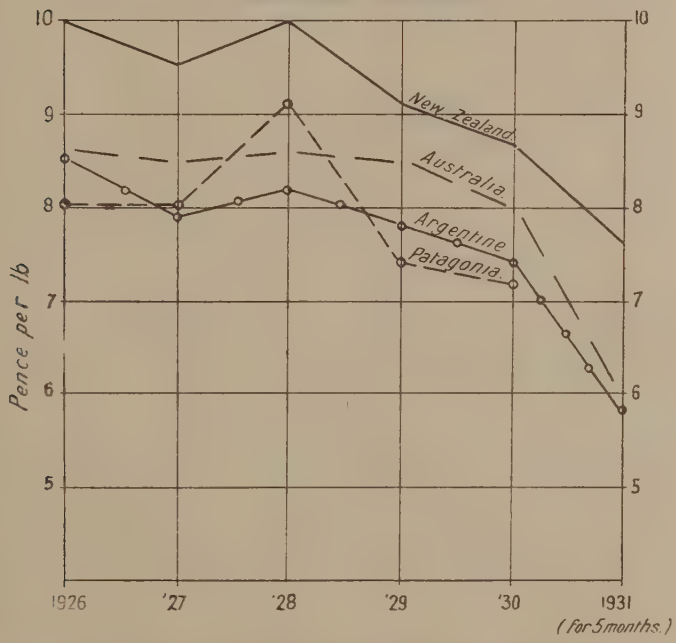
Only lambs which conform to the best features of the Southdown breed are in keen demand on the British market. Juicy and tender as Australians may have found the Merino lamb, particularly when eaten where it is produced, it is totally unsuited for the requirements of the British market, whose customers have become accustomed to sheep especially bred and selected for the excellence of their

meat. The Merino, on the other hand, has been developed, and marvellously developed, as a wool-producing animal and neither its shape, which is too angular nor the colour of its meat, which is too dark, meet the requirements of the British market.

In its present form there is thus NO MARKET for our surplus sheep either as mutton or lamb. Its character must be changed for there is a market, though at present well-supplied, for lamb of a certain type in the United Kingdom. Consideration must, therefore, be given to a change in our practice so as to produce the type of lamb required by this market.

DIAGRAM "E."

GRAPH SHOWING AVERAGE FROZEN LAMB PRICES AT SMITHFIELD MARKETS.



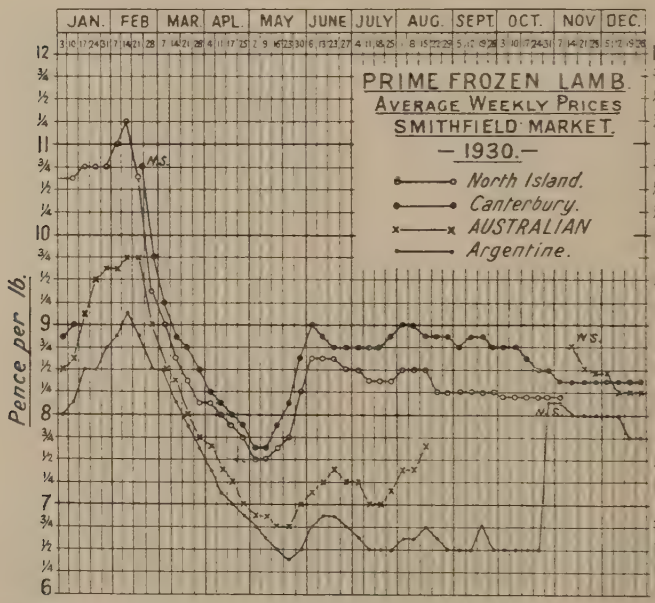
Unsuitable as may be the Merino lamb for the market of the United Kingdom, the Merino ewe, because it is the predominant West Australian type, must of necessity be the basis from which the suitable export lamb will be evolved. Fortunately, experience has proved that, by mating the Merino ewe with one or other of the more suitable British breeds, a great improvement in carcase qualities has resulted. As an example of this the production of the famous New Zealand "Canterbury" lamb may be cited. As pointed out by Dr. Nicholls, this lamb is produced by mating the Merino ewe with the English Leicester ram, and producing what is technically known as a Longwool-Merino crossbred. Experience at "Newmarracarra," "Cranmore Park," the Merredin and Chapman Experiment Farms, and elsewhere has shown that this cross is quite at home in parts of Western Australia. Probably, however, the related Border Leicester, similar in type, but of great robustness, will prove even more suitable for the major portion of our

agricultural areas. Neither cross, however, is as suitable for other than the agricultural and more favoured pastoral areas as the Merino.

Diagram E shews the average prices which have ruled at Smithfield market for frozen lamb from 1926 to date. From this it will be seen that the New Zealand lamb has held pride of place during the whole of the period, and that Australian lamb, though bringing about 1½d. per lb., less than the New Zealand, has held second place, except in 1928 when, for some reason which is not at present apparent, the price for Patagonian lambs exceeded that for Australian ones.

New Zealand lambs may be divided into two main classes, those coming respectively from the North and South Islands, the latter being given the distinctive name of "Canterbury" lambs, and which have earned a special reputation. Diagram F, compiled by Geo. C. Keen & Co., Ltd., shows the weekly prices during 1930 obtained by the different types of lamb, as indicated by their country of origin. From this it will be seen that, except on two occasions, the prices ruling for New Zealand "Canterbury" lamb were greater than those for either New Zealand North Island or Australian lamb.

DIAGRAM "F."



"Canterbury" lambs have held, and in a general way still hold, pride of place regarding quality and price in the lamb market of the United Kingdom. Within the past two or three years, however, the proud position of the "Canterbury" lamb has been contested, and successfully contested, in a few instances, by a further cross, *i.e.*, that by mating the Longwool-Merino ewe with the Southdown ram. One instance of this was reported last season (1930) by the Veterinary Officer stationed at Smithfield markets. *Inter alia* he writes in December, 1930: "There were three main shows of New Zealand lambs, consisting of prize lambs from the Royal New Zealand, Manawatu and Waikato shows. Nothing during

the month, or the year, for that matter, exceeded the display of Messrs. W. Weddell and Company of Salisbury lambs from the Waikato A. & P. Show. Keen judges with thirty years' experience were unanimous in pressing the opinion that nothing finer than the prize-winning lambs has ever been seen at Smithfield. As they consisted mainly of Southdown-Romney Marsh crossbreds, it is probable that nothing finer will be seen, and particularly as there was a delightful bloom on the carcases, the absence of which during recent times has given rise to so much concern."

The same Officer with regard to some Victorian lambs bred on similar lines wrote in September, 1930: "The 'Yarrawonga' Down Cross lambs which have been so favourably received always, have invariably made ½d. per lb. more than the best New Zealand and 1½d. or more over C.A.Q. Australian, and, moreover, they have established for themselves such a good name that they can be disposed of in advance of their arrival at this margin."

The "Yarrawonga" lambs so favourably referred to were, like the North Island New Zealand lambs, sired by Southdown rams, but it is understood the mothers were Border Leicester-Merino ewes. Both the Border Leicester and Romney Marsh breeds belong to what is known as the Longwool group of British breeds. The Romney Marsh, because of its very great and inherent resistance to foot rot, is specially adapted to districts where wet conditions and consequent risk of foot rot obtains. The Border Leicester, because of its hardiness and virility, is more adapted to drier conditions.

Here, then, is indisputable evidence that the supremacy of the famous New Zealand "Canterbury" lamb has been successfully assailed by a better type of lamb—the progeny of the Southdown sire and Longwool-Merino crossbred ewe. When they are critically examined, and due allowance is made for the special climatic conditions, and consequent requirements of the districts in which they were produced, the breeding methods followed are the same, and the guiding principle which should govern the breeding of West Australian export lambs is seen. In both cases the Southdown sires belonged to a distinct group of the British sheep, viz., the Downs group, the principal members of which known to W.A. farmers are the Southdown, Shropshire and Dorset Horn. Similarly, the mothers were the progeny of Merino ewes mated with rams belonging to another group of British sheep, viz., the Longwool group, to which belong the Leicester, Border Leicester, Lincoln and Romney Marsh, each of which is more suited than the others for a special environment, and all of which have been found to be very suitable for mating with the Merino, and when so mated produce progeny of similar characteristics.

The superiority of the Southdown cross lambs is again referred to in the report of the Veterinary Officer, London, for the month of October, 1930, when he wrote: "During the years I have been in London, in round figures Australia and New Zealand have shipped to the United Kingdom 4,000,000 and 17,000,000 lambs respectively. Some 4,000,000 of the New Zealand lambs have been "Down Cross," and they have brought roughly 2d. per lb. more than the 4,000,000 Australian lambs. The remaining 13,000,000 have brought 1d. or more per lb. more than the 4,000,000 Australians with the exception that a few Australian Southdown cross lambs have brought ½d. per lb. above the highest price obtainable for New Zealand lambs available at the same time."

The "few Australian Southdown cross lambs" referred to are undoubtedly the "Yarrawonga" Down cross lambs of the September report. That they should enjoy a superiority over New Zealand lambs of the same breeding and type is due to the better colour of the Australian lamb. This is brought out in the report of the Veterinary Officer, London, for January, 1931, in which it is stated, "As I have suggested before if there is one point of vantage which the Australian

lamb enjoys it is in regard to colour, and I am advised that with an Australian and a New Zealand lamb of equally good conformation and finish the preference should be usually awarded to the Australian."

The pre-eminent position of the "Yarrawonga" Southdown crossbred lamb on the market of the United Kingdom is of particular interest to Western Australia, for Yarrawonga is an agricultural district situated in the North-West part of Victoria on the Murray, about mid-way between Dookie and Deniliquin, with conditions very similar in character to those which obtain in the Avon Valley and Moora districts. What can be done in a district like this can be done equally as well in Western Australia, provided the same methods are adopted. The experience of Mr. S. B. Rudduck, of "Koobabbie," Coorow, and of Mr. W. G. Burges, of "Tipperary," York, and others with the Southdown-Longwool Merino crossbred is definite evidence that this type can be produced in Western Australia.

The practical inferences to be drawn from these facts are that the British buyer desires, and is prepared to pay the best price for Southdown crossbred lambs and that Western Australia should produce this type wherever possible, for thie West Australian lamb, in common with other Australian lambs, will also securs the premium merited by its better colour.

The correct type or conformation will be secured only by breeding, and this is the first essential for success in connection with the production of export lambs, but as with dairy cattle, a second and equally important one is FEED. Export lambs require to be marketed as suckers from 12 to 16 weeks' old, and to provide the "bloom" and finish necessary to meet successfully the strong competition at Smithfield, ample feed is essential from the time the lamb is dropped until it is sent to market as a "sucker." The New Zealand farmer finds it necessary to supplement the excellent natural pastures with specially grown fodder crops. like rape and turnips. He regards export lamb raising as a specialist's business and makes provision for ample supplies of the necessary feed. The West Australian farmer must do likewise and grow those fodder crops—oats, rape, peas, turnips, etc.—for which his district is best adapted. At first sight Western Australia would appear to be at a disadvantage with New Zealand in this connection, because of its shorter growing period, but, when it is realised that the growing season required by the export lamb is only 12 to 16 weeks it seems likely that this State with its Mediterranean climate and quick winter growth, has an advantage over New Zealand in this respect.

From Diagram F it will be seen that on two occasions during 1930 the price of "Canterbury" lambs did not, as is usual, exceed that of the other brands. The first period was from the second week in January to the second week in February ; the second period was from the second week in November to the first week in December. On both occasions the loss of the premier position was due to the fact that new season's, *i.e.*,fresh lambs, of both types, were preferred to the end of season, or lambs that had been in store for some time. This indicates that in this abundantly-supplied market there is an advantage in having new season's lambs, when those of our competitors are comparatively stale, and as early as possible in the Australian season.

Because of its geographical position Western Australia has two advantages over the Eastern States producers, and they are—

(1) The season is earlier, and

(2) The period of transport from loading port to market is shorter.

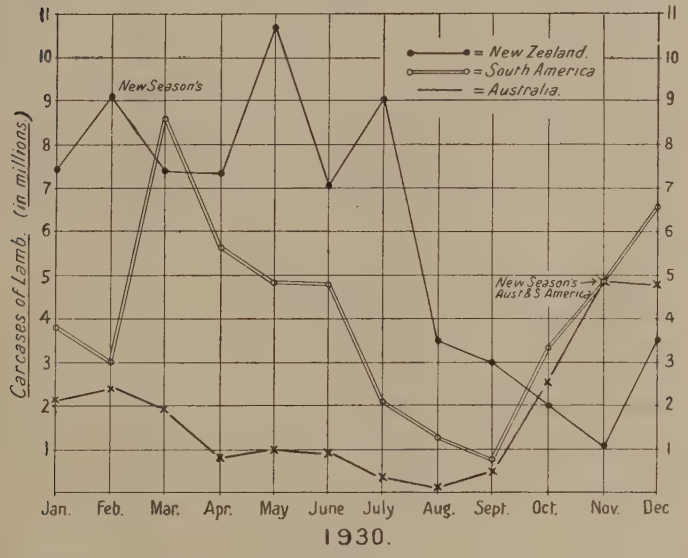
Because of these factors West Australian lambs should be the first of the Australian lambs on the London market. How great is this advantage is shown by the following statement by the Chief Veterinary Officer (R. P. Allen): "The

best prices in the United Kingdom for Australian lamb are always obtained for new arrivals, say, September. The earlier the lamb arrives in the United Kingdom the better the price."

From Diagram G, it will be seen that the lamb imports from the principal importing countries to the United Kingdom are at their lowest during the months of August and September, whilst the supplies arriving are not great until November. Because of the early season Western Australia should be able to take full advantage of this, and land its lambs so as to escape the keener competition which must obtain when full supplies are coming forward.

Diagram "G."

GRAPH SHOWING LAMB IMPORTS INTO GREAT BRITAIN, 1930.

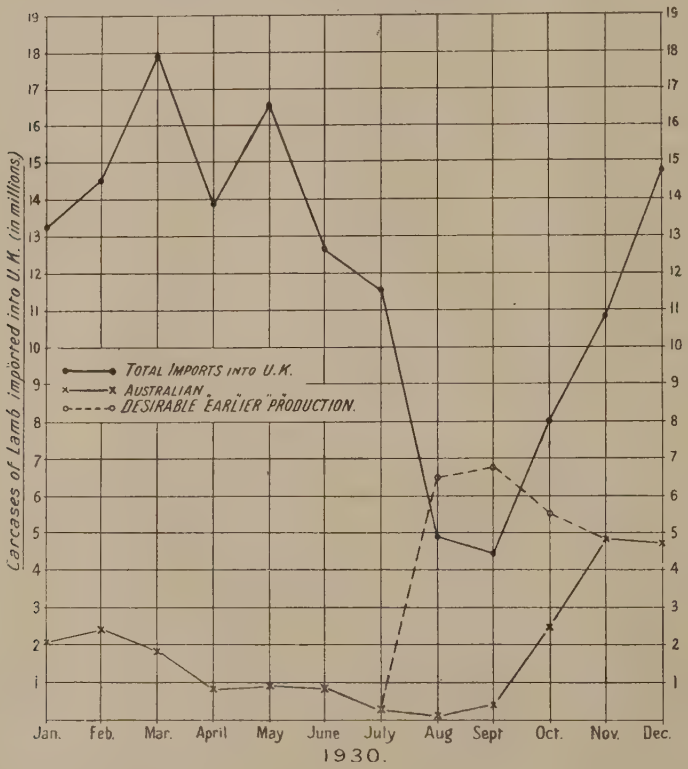


These two advantages of colour and earliness enjoyed by Western Australia must be utilised to the utmost, and an effort should be made to change the direction of the curve representing the exports from Australia to that represented by the dotted line in Diagram H, so as to provide that the export of lambs from Western Australia shall commence as early as possible, and as many as possible be sent away so as to arrive in England during the period August to November, when the imports from our competitors are at their lowest. In this fight for more remunerative returns it is not sufficient to take advantage of our geographical position ; the quality of our lambs must be improved. It will be seen from Diagram F that in February, when the new season's Canterbury lambs came on to the market, their selling price was 2d. per lb. better than the Australian price because of better quality. If Western Australia is to have its proper share of the British market then it must produce export lambs which, as regards uniformity and quality, are equal to New Zealand, so that the West Australian lambs can meet the New Zealand ones at the same time on equal terms.

The production of export lambs has special advantages for the agricultural areas ; in the first place it ensures the maximum number of sheep being carried when feed is most succulent and abundant, and the minimum when it is scarcest and driest. Further, the crossbred mother, for which there is a keen demand, produces excellent wool, and is very suitable for farm conditions ; it is an infinitely better scavenger than the Merino, and therefore better adapted to assist in cleaning the fallowed land.

DIAGRAM "H."

GRAPH SHOWING IMPORTS OF LAMB INTO U.K.: TOTAL AND AUSTRALIAN, 1930.


Carcases of Lamb imported into U.K. (in millions)
TOTAL IMPORTS INTO U.K.
AUSTRALIAN.
DESIRABLE EARLIER PRODUCTION.
Jan. Feb. Mar. April May June July Aug Sept Oct. Nov. Dec.
1930.

Farmers have realised the necessity for a change in their sheep husbandry, as evidenced by the export of lambs in 1922 and 1923 already referred to, and through the courtesy of Mr. Gray, of Messrs. Elder, Smith, & Co., Ltd., I have ascertained that 60,520 lambs were marketed at the Metropolitan markets between the months of July and November, inclusive, in 1929, and 161,860 in 1930 ; of these latter 23,231 were exported. It is expected that this year there will be from 40,000 to 50,000 (only about 6 per cent. of the surplus) available for export. These are, however, of many types, and there are far too few of those for which the highest price is obtained. This must be altered so that there is much greater

uniformity and general inprovement in type by standardising the methods of lamb production.

In the September, 1930, report of the London Veterinary Officer, previously referred to and relative to the "Yarrawonga" lambs, he implies a "good-will" due to a reputation not only for "quality" but for "*uniformity*," and, in our desire to obtain a footing on a crowded market the fact that this is recognised and paid for must be utilised to the advantage of the State. Our aim must be to develop a special uniform type of lamb to be known, say, as the "Swandown Lamb," similar in quality to the "Yarrawonga" Southdown crossbred lamb, and to achieve a reputation for it.

With the experience of the past to guide us it is believed that, for the conditions which obtain in the major portion of the agricultural areas, the Border Leicester is better adapted for mating with the Merino than any other breed of the Longwool group, and similarly, the Romney Marsh for the wetter districts where foot rot is feared ; the ewes resulting from either of these crosses to be mated wherever it is possible with Southdown rams.

The experiments conducted by Colebatch & Scott at the Roseworthy Agricultural College supply some very useful information regarding the financial returns likely to result from such a policy as outlined. From Table X. it will be seen that the most profitable returns were obtained from the cross which is in most demand upon the British market, and which is obtained by mating the Southdown with the Border Leicester-Merino ewe.

TABLE X.

MONETARY RETURNS FROM SALE OF LAMBS.

Ram.	Ewe.	Value of lambs (per 100 ewes.)	Lamb pelts (per 100 ewes.)	Net return from each flock (per 100 ewes.)
		£ s. d.	£ s. d.	£ s. d.
Merino	Merino	78 0 2	26 9 4	163 0 2
Lincoln	Merino	104 8 9	26 6 6	189 8 9
English Leicester ...	do.	107 4 7	27 13 1	192 4 7
Border Leicester ...	do.	111 17 3	26 0 7	196 17 3
Romney Marsh ...	do.	82 11 4	21 14 4	167 11 4
Dorset Horn ...	Merino	92 5 6	20 13 4	177 5 6
Shropshire	do.	92 11 7	21 6 3	177 11 7
Southdown	do.	99 19 9	21 3 6	184 19 9
Dorset Horn ...	Border Leicester-Merino ...	127 15 3	27 0 4	198 3 7
Shropshire	do. do. ...	119 1 3	25 16 8	189 9 7
Southdown	do. do. ...	131 10 8	27 1 0	201 19 0

From Experiments at Roseworthy Agricultural College, South Australia.

This was closely followed by the cross Dorset Horn x Border Leicester-Merino ewe. From this table it will also be seen that, with the exception of the Romney Marsh, it was more profitable to mate the Merino with the Longwool breeds—Border Leicester, English Leicester and Lincoln than with the Shortwool or Downs breeds, though of these latter the Southdown, when mated with the Merino, proved the most profitable ; the pure Merino was the least profitable. The prices for both wool

and carcase then ruling were very decidedly better than at present and were—for Merino wool AA fleece 21½d. ; for cross-bred wool AA fleece 20d. The average price per lb. obtained for lambs of first quality—28lb. to 36lb.—was approximately 10d. per lb.

Because of the crossbreeding which is essential the production of export lambs is not as simple, nor as easy, as that of raising Merinos ; to produce the necessary type involves the production of three separate types of sheep—

(a) the Merino ;

(b) the Longwool x Merino mother ; and

(c) the Down export lamb.

The production of these three distinct types is too complicated for the average farm, but, if the general State policy for the production of export lambs is such that each section is treated separately and specially, and allotted to the districts best adapted to each, the position is immensely simplified and presents no difficulty to any farm.

Under such a system each breeder would undertake the production of one type only and generally the production would be as under—

The pastoral areas would produce the Merino mothers ;

The outer wheat areas the Longwool mothers, and

The inner Wheat Belt and the Clover Belt the Export Lamb.

Such a system would have the added advantage that, though the pastoral area cannot raise the export lamb, and therefore directly benefit by its production, it would indirectly and materially benefit as the result of supplying the Merino mothers for the Longwool crossbreds, and thus find a market for some of its otherwise surplus sheep. The outer Wheat Belt would dispose of the wethers as export lambs and the ewes to the breeders of the "Swandown" export lambs.

The conclusion is inevitable that there is no market for our surplus sheep in their present form. To secure a market it is necessary to change the character of our sheep husbandry in the agricultural areas, but this can be done without economic loss. The production and export of fat lambs to the market of the United Kingdom offers the only solution of the problem of our surplus sheep.

To meet the requirements of the British market the export lamb must be marketed as a "sucker" direct from its mother ; this is also necessary for economic reasons, as this type of lamb is an unprofitable wool producer and cannot, therefore, be carried profitably through the spring and summer until it is older. In this respect it is quite unlike its crossbred mother, but from the State's standpoint it is an advantage rather than a disadvantage, for it means that the export lamb raiser does not retain any of the young stock to carry on his operations, and hence the surplus in the pastoral areas must be utilised to meet the demand for breeding stock.

This is also essential to minimise the severe competition in an over-supplied local market, because this phase of the sheep industry offers as great or greater financial returns than the production of Merino wool ; it is also well suited to our climatic conditions and at the same time it has the economic advantage that it provides an outlet for some of the surplus sheep in the pastoral areas. It is hoped that it has been shown that this can be done with economic safety, for it will necessitate the further development of, and increased expenditure on our farms, but, because of the developed state of our farms, the increased expenditure is only a fraction of what would be necessary if the development for this export trade had to start *ab initio*. With the increased expenditure there would be resumed, at least in part, that development which had to cease in both agricultural and pastoral

areas with the collapse of the wool market, and thus the profitable disposal of our surplus as Export Lambs not only offers relief to the pastoralist and agriculturists but in its train provides profitable work for the unemployed, and so relieves a congested labour market.

Summed up the position is—

1. There is a sheep surplus in the State of over 800,000 for which there is no export market in its present form.
2. There is an export market in the United Kingdom for lambs of a suitable type.
3. New Zealand until recently obtained best prices with "Canterbury" lambs, *i.e.*, English Leicester x Merino crossbred lambs.
4. This position has been successfully assailed and improved export lambs produced by mating the "Canterbury" type ewes with Southdown rams.
5. This type can be produced in the agricultural areas by mating the Southdown with the Longwood Merino crossbred ewe.
6. Western Australia has an advantage over Eastern States competitors in this market because our season is earlier, and the distance from the market shorter; in consequence, the State is very favourably situated to attack the market when its imports are at the lowest.
7. Because of the competition due to an abundantly supplied market it is essential to supply the best quality for which the British consumer is prepared to pay.
8. Western Australia can and must produce the same type, and earn a "reputation" for it.
9. This will involve the production of lambs of uniform and standardised quality, and requires a State-wide policy with regard to the breeding of the Export Lamb.
10. Results at Roseworthy have shown that better financial returns will accrue to farmers working along the lines suggested.
11. The West Australian lamb, in common with that of other Australian States, has an advantage over the New Zealand lamb with regard to colour, and this will bring enhanced prices.
12. The economic aspect of the industry will be improved by changing the character of the sheep husbandry in the agricultural districts, and thus directly removing the surplus from them, at the same time providing a market for at least some of the surplus sheep in the pastoral areas.

"KOOBABBIE" METHODS.

A. M. RUDDUCK, "Koobabbie," Coorow.

The first essential in the raising of fat lambs is to secure suitable mothers, *i.e.*, crossbred ewes of the right type. For this purpose large-frame Merino ewes are mated with Border Leicester rams. The wether lambs are sold as suckers and the ewe lambs retained for breeding purposes. When mating Border Leicester rams it is not desirable to place the full number of rams with the ewes; if this is done the rams run by themselves and neglect the ewes. Yarding with the ewes at night has been tried, but the method now adopted is to introduce the rams singly; as each one joins the flock another is added until the full complement is reached. Two per cent. of healthy, vigorous rams is sufficient.

These crossbred ewes are mated as two-tooths with Dorset Horn, Southdown, or Border Leicester rams. The whole of the lambs from the above are sold as suckers; the ewe lambs could probably be used to produce good mothers, but from a wool-producing point of view they would be undesirable to carry as ewes from year to year.

The feeding of the ewes during the dry months is a point of great importance, and receives due attention. They are run on natural pastures until the stubbles are ready. When these are finished the ewes are returned to the grass paddocks; these are never eaten bare and always have some feed on them during the summer. Hand-feeding is resorted to while there is still plenty of natural feed. By providing a choice of food in this way the amount of waste during the hand-feeding period is negligible. Hay is used supplemented by a small quantity of oats or wheat. The crop is cut for hay when just past the flowering stage, and both oaten and wheaten hay are used successfully. Commercial feeding stuffs like linseed cake have been tried, but as hay, oats, and wheat are grown on the farm and produce prime lambs the use of purchased foods appears uneconomical.

The feed is placed on the ground, not in feeders. The quantity of hay and grain feed depends upon the supply of dry feed remaining in the paddocks, and varies from ½ to 1 lb. of hay and the same weight of oats or wheat per day. The period between the first rain and the advent of grass is always most difficult for hand-feeding, but given a good fall of rain at the opening of the season, followed by showery, moist weather, some of the paddocks will carry a ewe to the acre a week after the first fall. The feed is then young barley-grass supplemented by the old dry feed.

Oats are sown each year to supply early feed for the ewes and lambs, but they much prefer to be moved over fresh grass paddocks. Past experiences have proved to us that it is inadvisable to feed off wheat crops, lest we should have a light rainfall or an early spring. If such should occur the wheat yield is reduced by feeding back. Here it may be mentioned that the paddocks have been liberally treated with superphosphate. Without this few lambs would be fattened, and certainly not for the early market.

The lambing paddocks each contain about 100 acres, and when the lambs are dropping the flock is each morning moved to a fresh paddock, leaving behind, for a day or so, those ewes which have lambed during the previous 24 hours, after which they are moved to feed as good as the season permits. As far as possible the mothers are kept in groups of about two hundred for the convenience of lamb-marking and to facilitate moving to fresh pastures.

When the lambs are ready for market they are taken from their mothers on Monday morning, driven five miles that afternoon, yarded for the night, driven

eight miles next day, placed in the truck by 4 o'clock, and, after a rail journey of 152 miles, sold at Midland Junction market on Wednesday.

Particulars of the rainfall during the growing period, the methods of mating and results of the marketing of lambs for the past three seasons will prove of interest. They are as follow:—

RAINFALL.

Year.	Mch.	Apl.	May.	June.	July.	Aug.	Sept.	Oct.	Total for year.
1929	10	0	373	334	13	78	10	50	1,266
1930	114	155	55	598	254	119	68	82	1,471
1931	30	92	232	98	243	120*	...	...	...

* Up to 25th August.

The first useful rains were as follows:—

1929—2nd May, 16 points; 3rd May, 88 points.

1930—16th April, 24 points; 18th April, 18 points; 19th April, 90 points.

The splendid April rain lost much of its value owing to the long dry spell that followed, the balance of April and the whole of May supplying but 57 points.

1931—7th April, 47 points; 12th April, 20 points.

Both these falls were showers induced by thunder, and fell over a very limited area. The season broke on 4th May, when 138 points were distributed over four days. June was dry—98 points only—and cold, with heavy frosts. The feed was short and discoloured.

In the respective years the ewes were mated and the lambs marketed as follow:—

1928—Rams joined with ewes 30th November and 1st December.

Lambs sold at Midland Junction, 1929:—

	July 31st.	Aug. 7th.	Aug. 14th.	Aug. 28th.	Sept. 4th.	Sept. 11th.	Sept. 18th.	Sept. 25th.
Number ...	40	160	70	82	163	175	27	11
Prices	29 7	27 7 25/1	24 10 23/10	27 4 25/10	20 4 18/10	22 4 18/10 18/–	16 1	16 10

1929—Rams were joined with ewes 30th October and 2nd and 11th November.

Lambs sold at Midland Junction, 1930:—

	July 2nd.	July 16th.	July 23rd.	July 30th.	Aug. 6th.	Aug. 13th.	Aug. 27th.	Sept. 10th.	Sept. 24th.
Number ...	80	160	125	160	234	236	60	80	39
Prices ...	22 4 21 4	20 4 18/1	18/7 18/1	15 7 14 10	20/1 18/1 17/1	17 10 16 4 14/4	14 7 13 10	16 7 16 1 14/–	12 10 10/10

(Some of the lambs each year were first cross, *i.e.*, the progeny of Border Leicester rams from Merino ewes.)

1930—Rams were joined with ewes as follows:—

Flock A—300 crossbred ewes—

1st November—6 Southdown rams.

Flock B—760 crossbred ewes—

1st November—7 Dorset Horn rams.

16th November—3 Border Leicester rams.

17th November—6 Dorset Horn rams.

The mating procedure in connection with the ewes to be joined with Dorset Horn rams was adopted because it has been found that with that breed, if too many rams are placed with the ewes at the beginning of the mating season, there are not enough ewes to go round and then the rams fight and disable themselves, sometimes permanently.

The dates hereunder on which the lambs were born in 1931 may be of interest. The figures represent the lambs counted each day, and are approximately correct:—

March 31—2.

April 2nd, 2; 3rd, 1; 6th, 5; 7th, 2; 8th, 16; 9th, 8; 10th, 6; 11th, 7; 12th, 11; 13th, 10; 14th, 22; 15th, 23; 16th, 23; 17th, 44; 18th, 43; 19th, 40; 20th, 90; 21st, 56; 22nd, 80; 23rd, 61; 24th, 44; 25th, 40; 26th, 30; 27th, 45; 28th, 30; 29th, 30; 30th, 12.

May from 1st to 8th, 91; from 9th to 19th, 61; from 20th to 29th, 32.

The balance were dropped in June and July.

For the present season 1,060 crossbred ewes were mated. From these 1,051 lambs were marked. Some lambs died at birth; foxes killed others. About 50 ewes were not in lamb. Three ewes died through lambing troubles. Two ewes died later in the season from an unknown cause. Thus the loss from 1st November to 30th June—eight months—was 5 ewes.

The lambs were sold at Midland Junction, 1931—

—	July 8th.	July 15th.	July 22nd.	July 29th.	Aug. 5th.	Aug. 19th.	Aug. 26th.
Number ...	80	117	180	180	162	132	152
Prices ...	15/4 14/10	16/10	15/7 15/1 15/–	15/10 14/10	16/4 15/7	14/– 13/10	15/4 14/10

The consignments sold on the 8th and 22nd July were stained in the trucks, and it is estimated that, because of this, the prices realised were reduced by 1s. to 1s. 6d. per head, and this was a direct loss to the producer. Since that time tarpaulins have been secured each week to protect the lambs.

Our experience to date is that the lamb sired by the Dorset Horn ram matures about two weeks earlier than those sired by other breeds. Lambs have been sold at ten weeks, but twelve weeks is about the average age of marketing. Twin lambs, unless the mother has a heavy flow of milk, mature later than single lambs.

THE EXPORT FLOCK AND ITS CARE.

W. G. Burges, "Tipperary," Burges Siding.

Having first obtained the right type of ewe, and that must, in my opinion, be the progeny of the Longwool British-bred ram from a large-framed Merino ewe, the next thing to consider is the mating and feeding.

Ewes should always be kept in good healthy strong condition, and about ten days before mating should be given some fresh, good pasture and kept in good order during the mating period. I would suggest not more than 250 in each flock, and first put in, say, four rams and follow on in 14 days' time with the balance; 2½ to 3 per cent. will be found the best percentage of rams to be used. This will get a more even drop than using a small number of rams. Only use one breed of ram to each flock (it is sometimes advisable to put in a vigorous worker like the Dorset Horn towards the end of the period to ensure all ewes being in lamb). Should any of the rams be falling away, take out and feed up for a few days and then put back again. This will often save the loss of a ram later on. Keep rams in from 10 to 12 weeks. Shear and dip rams early; also dip ewes at least one month before mating.

A month before lambing (this entirely depends on the season) ewes want extra feed, and at this period care should be taken that they do not lose condition. If the ewe at this period is allowed to fall away it will have a detrimental effect on the future lamb. Crutch ewes at least one month before lambing.

During dry weather the ewes may be fed on the ground, taking care that the fodder is distributed on a fresh place each day and the more grass it is put on the better. It will be found that, if this is carried out, feeding dry oats will be the most economical. Starting early, 4ozs. per day will keep the ewes in excellent order. Wheaten or oaten hay (the hay should not be from fallow) are useful fodders, but there is always a little waste from hay.

The worst period to feed is after rain. Here feeding on the ground is wasteful and I suggest bag feeders as the most economical, giving the ewes from ¾ to 1 lb. of chaff and 6 to 8 ozs. of oats added.

Care must be taken to see that the whole of the flock can get its proper share of the ration. The objection to automatic feeders is that they afford special opportunities for the stronger ewes to get too much feed at the expense of the weaker sheep, which get tired of coming along and failing to get their ration. Further, the lambs get badly boxed and trouble generally occurs.

Silage is most useful mixed with a little chaff or oats, but I cannot advise putting up expensive silos at this period. If the ewes are kept strong by feeding before the wet weather comes along little trouble may be expected when the rains come.

During lambing the ewes should have attention first thing in the morning and last thing at night. This will repay a man's time over and over again in the saving of mothers and lambs.

The lamb having been dropped, mark every three weeks. When yarding for this purpose be careful to leave all young lambs behind in the paddock.

Draft all dry ewes when lambing is finished. They are eating your best feed, which the mothers require, and further, often get too fat and do not get in lamb the following year. I consider it a good plan to sell the older dry ewes to the butcher.

From now on the ewes and lambs should be kept on the best of pastures, and must not receive a check in any way. Growing oats is of very great assistance;

pasture should, however, be available. It is advisable not to have the crops on too wet land, otherwise in cold frosty weather the lambs may get sore-footed, which would easily throw them back a fortnight.

When the lambs are fit to market, draft off from the mothers; the lambs can then be hand-picked without undue knocking about. Great care must be taken in not grabbing the wool or legs, otherwise bruises will result. It will generally be found that about 30 per cent. of the lambs will be ready at one time. To save your best feed it is advisable to take off the mothers of the lambs sold. This can be done by putting the ewes in a small field near the drafting yard. The mother will make back to the yard and then can be run off. To make sure no error has been made, place the ewes with lambs in one field and the other lot in an adjoining field, and, if there are a few on the wrong side, they can easily be found the next morning.

One of the greatest mistakes most of us make is overstocking. It should be realised that it is much better to have two first-quality lambs than three medium ones. It is also a bad proposition to fatten a number of wethers on your stubbles and starve the prospective mother.

Summed up, the position is:—

1. Get a good crossbred ewe;
2. Use only one breed of ram in each flock;
3. Keep ewes in strong, healthy condition;
4. Flush with good feed just before mating;
5. Look up ewes morning and evening during lambing;
6. Feed well after lambing;
7. Grow oats and other suitable pastures; and
8. Handle lambs carefully during marketing.

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IN QUEST OF THE EARLY "SWANDOWN" LAMB.

E. H. B. Lefroy, "Cranmore Park," Walebing.

This is such a new country with so many problems to face, and there has been so little time for really thorough investigation by anyone, that no greater harm could be done than by attempting to dogmatize. All that can be done safely is to say: "These are the things I have seen, these are the places I have seen them, such are the conditions under which these things were seen and such are, to me, the apparent results."

A trap into which all of us who have spent our time on the land are liable to fall is that we imagine we know, whilst really we only think we know. The circumference inside which most of us work and think and observe is necessarily a small one, so that if, after many years of experience in one small circle we become arrogant in our opinions and in our attitude towards the expressed opinions of others, perhaps we may be forgiven by those who are broadminded enough to make allowances. And when I accede to a request to write this little article let it be understood that I merely set out to state some of the results of my own experiences and the experiences of those with whom I have come in contact under Western Australian conditions, particularly in the Moora District, during the last 22 years.

It is desired that this contribution should touch on the subject of a rational sheep policy for adoption by the Agricultural and Southern areas of Western Australia, with a view to the best interests of the State and of the industry. There is great scope for such a subject, and much more ground needs to be covered than such an article as this could hope to deal with adequately.

So far as the sheep industry in Western Australia is concerned, certain things seem pretty definite:

(1.) We are faced with an alarming surplus sheep problem.

(2.) Development in both the Pastoral and Agricultural Areas to enable the State to carry more sheep has stopped dead, and any early increase in our sheep-carrying capacity seems improbable.

(3.) It appears unlikely that breeding sheep in our farming areas for wool and for the local mutton market only will be profitable in that future which we are able to visualize.

(4.) There is a market for lambs of the RIGHT QUALITY in London.

(5.) The competition on the world's market for lambs is becoming fierce and increasingly so.

(6.) Western Australia has a special advantage over other lamb exporting countries, owing to the time of year our lamb season occurs, **provided we send our lambs away early.**

(7.) Under proper management (breeding and feeding) our farmers can produce the lamb London favours.

(8.) The favoured lamb is of the Downs Cross.

(9.) The pre-eminently favoured lamb for Australian export is the product of a Southdown ram from a ewe of the Longwool-Merino type.

Although our experience is not by any means so extensive as we might like in connection with the Southdown crossbred lamb, we have data which encourages us to believe we can made a success of the production of this ideal lamb. There

is reason to hope that Western Australia can produce this type of lamb, and that a reputation for quality can be achieved with it. So as to secure the full advantages of such a reputation, if the anticipations be realised, the special type should have a distinctive mark or brand, for which the name "Swandown" is suggested.

Though Smithfield (London) places the Southdown cross lamb on the top, and the best lambs from Australia and New Zealand are of that cross, it is not safe to assert definitely that Western Australia will make her greatest success in lamb breeding as the result of using the Southdown, even though an endeavour is being made to produce the best and compete successfully with other countries.

The "Swandown."

Southdown-Border Leicester-Merino.
Tipperary, 1931.

It must be pointed out, however, that since the competition in this trade will inevitably be so great, nothing but the best will help us much. The best will always find a market.

Now we do know about the Southdown that he is slower in reaching the export age than several other breeds, and amongst these breeds of quicker maturity is the Dorset Horn particularly. Further, the experience of some breeders indicates that the Southdown ram is not so prolific as that of some other breeds.

The experience of Mr. C. L. E. Orton, of "Petworth Park," Moora, has been much in favour of the Southdown ram as a sire of fat lambs. Mr. Orton has been a careful and successful breeder of fat lambs for over 20 years at his property, "Petworth Park," and he has experimented with a number of English breeds of rams. Although he readily admits the Southdown is slower in maturity than several of the other breeds, he quite definitely places this ram in the first place. He has found him particularly vigorous and prolific. A larger percentage of exportable lambs are obtained from his drop than from any other breed. In fact, as one who has had the opportunity of making special inquiries at Smithfield and one who has a good knowledge of English requirements and English sheep breeding practices, Mr. Orton, for the purpose of breeding his own lambs for the Smithfield market, is a straight-out and convinced Southdown man. So much so that arrangements have been made by him for the importation of stud ewes and rams of the breed for use on "Petworth Park."

My own visit to Smithfield left no room for doubt as to the importance of the Southdown. So it is hoped the Southdown will be given every chance to prove his worth in Western Australia.

There can be no doubt about the advisability of commencing **early** with the export of lambs from Western Australia, and bound up with this is the debated question of Early or Late lambing. In view of the value of the Southdown as a sire of export lambs, and as this breed matures more slowly than the Dorset Horn this matter is of particular interest. There are two schools of thought about this matter: there is the Early school—those who advocate that the lambs should be dropped, say, from the middle of March to the beginning of May, and the Later school—who believe that lambing should be delayed until May or June, when there is every probability that there will be green feed for the lambing ewes. Of this, like many other matters, it may be said that both are right **sometimes**. It depends entirely upon circumstances.

My belief is that a definite period for lambing should be fixed to suit the circumstances. Proper provision should be made for a successful lambing at the time decided upon as being the most suitable. Some of our most successful breeders are mating early in November. Usually the result from mating at that time would be that the bulk of the lambs drop between the middle and the end of April. Queer things do certainly happen at times, sometimes not easily accounted for, and, in consequence, there can be no certainty as to how quickly ewes will become in lamb. In making statements as to how long it will be before lambs will drop after mating we are necessarily guided by the rules which govern such cases, and which are founded upon probabilities. The exception has annoying habits at times.

To begin with, no farmer who hopes to make a success of export lamb production can do other than handle the stock on his farm on rational and conservative lines. His sheep must at all times have sufficient feed of some kind. Suitable water, even though it may be a little salty, is essential.

With regard to lambing dates, the circumstances now being discussed seem to demand that, for maximum results, the earlier lambing should be adopted. It is advisable that advantage be taken of the better prices obtainable in London for the lambs exported in the early part of the season, and, therefore, provided breeders are prepared and able to make the necessary provision of feed for their ewes, I have no hesitation in recommending the earlier lambing produced by mating, **say, from 10th to 15th November.**

For Early Lambing.—Preparations should be well in hand before lambing commences. Crutching should have been carried out and feeding to supplement the natural grazing already commenced.

To successfully carry out early lambings it will be found necessary on most farms to provide some feed other than the natural pasture for the use of the ewes when lambing. Where there is good oat stubble with some good dry clover it may not be necessary to supplement this with other feed, but it nearly always pays to do so.

As to how to feed the ewes most successfully and most economically is a very open question. It probably would be true to say there is no best way. So much depends upon circumstances, what feed the farmer can most economically grow, whether it is a good season, whether he has much old natural feed, etc. But let it be assumed that the conditions are those of an average farm inside the typical fat lamb raising areas, say, the 15 to 20 inch rainfall country; the farm has not been overstocked; that there is fair old natural feed on the ground, and that there is also on hand some green chaff from hay cut in the flowering stage, and not from a rank crop. My experience is that chaff cut short from either wheaten or oaten hay of suitable variety ("Burt's Early" oats and "Baroota" wheat) will make excellent sheep feed. No doubt others have found other varieties equally suitable and prefer them.

It can also be reasonably assumed that most farmers, in addition to producing chaff, can even more easily make provision for a supply of grain for their sheep. An economical method of storing oats is in bins to hold, say, 500 to 1,000 bags.

Chaff and oats are natural and economically produced feeds under the commonest conditions in Western Australia. There is, of course, silage, and some can grow peas successfully, and again, in some places lucerne has a place to fill. Perhaps someone else will tell us about those things. The majority of farmers have not reached that stage yet. Nor can the comments of the lupin enthusiasts be ignored. Lupins, too, appear on the horizon but have yet to arrive, so far as most of our farms and many of our farming districts are concerned. For the present let us make the best of what we have, while seeking always for something better. Chaff and oats are within the reach of most farmers.

Oats appear to have special virtue as sheep feed. It gives the sheep "kick" and strength, and seems to provide a great deal of what mere chaff or other dry feed lacks. The sheep may not look any the better for having oats at the time of feeding, in fact a lot of bulky stuff is often deceptive as it makes the sheep look full, whereas a smaller but more nutritious ration containing oats may not show the sheep to the same advantage. The great benefit is seen after the rains come and the sheep get on to the green feed. Diluted with good chaff, oats make a good ration. It is economical and gives satisfactory results. I have been told that oats are not nearly so good as potatoes, onions, lucerne, linseed and what not. That is all right, perhaps, if you have money with which to buy luxuries, but we are trying to make the best of what we can reasonably grow.

What quantity per day should the ration of chaff and oats consist of? The best reply to that is to see what your ewes require to keep them well. It would be foolish to lay down a definite amount. It may be suggested, however, if the ewes are still in nice condition and if there is still a fair amount of bulky dry natural feed, that a half pound of oats per day and a quarter pound of chaff, will

probably suffice. This is not merely a guess. If there is no dry feed, more chaff will probably be needed. For more generous feeding add more oats. If short of oats even a quarter pound with the quarter pound chaff is a great help. The last issue of the Journal of Agriculture had some helpful figures on the subject of feeding and included the use of silage.

Long hay, cut green and fed on the ground or in racks, is the menu provided by some farmers for their sheep. It certainly saves a lot of chaffcutting, but I am inclined to believe is the line of least resistance and lesser results. Although it is by no means an uncommon practice and appears to be preferred by some people, we do not give this method pride of place. That is probably a matter of opinion and not a matter of the greatest importance. Both methods have their advantages and their disadvantages. I do not not recommend automatic sheep feeders.

If using feeding troughs for the chaff and oats the usual way is to erect two parallel rows of posts, say 10 inches high, and about 16 feet apart in the rows. Bore a hole near the top and run wires through to hold bagging. Split old cornsacks or sound super bags longways and sew together, thread the wire through the edge of the bagging. Make a sharp point on the wire so as to thread easily. The feeder should touch the ground so as to take the weight and save wear. Allow one foot in length for each ewe, *i.e.*, 100 ewes per 100 feet of feeder. They don't take long to erect. Keep a needle and some hay bands at each feeder for a stitch in time.

Jarrah seconds 9 x 2 for bottoms and 9 x 1½ for sides, in lengths up to about 10 or 12 feet make fine permanent feeders. It is a good plan to fasten hoop iron around the ends of these with screws.

As to how long before lambing should the feeding commence, and how long after rain should it be continued, must be decided by circumstances. There are some seasons, when rain comes early and is followed up, when feeding is not necessary. Unfortunately this is not often under Western Australian conditions. But although nature has given us a long dry summer we are blessed with conditions that make the provision of some artificial feed relatively easy and practically assured. It is the rarest event for the safer parts of our agricultural country to experience a really dry winter and spring. We know, almost for certain, that the conditions will be droughty in March and April and often into early May. But in the methods indicated we have means whereby provision for this can be quite well arranged and thus make it possible to have the lambs well on their feet by the time natural green feed is available. These provisions it seems must form an important and accepted part of any successful system of sheep keeping that may be evolved.

This article does not set out to give the last word in anything. There is much to be learned by all of us. It is only by the dissemination of the results of our reactions to experiences that the sum of general and useful knowledge can be added to. It is, however, hoped that the contribution of this mite may be at least of some help to those who have been less fortunate in their opportunities for first-hand observations.

CONFORMATION AND TYPE OF EXPORT LAMB.

HUGH MCCALLUM,
Sheep and Wool Inspector.

The fact that the Merino ewe is the foundation of the fat-lamb industry in Western Australia cannot be overlooked, and to make a success of lamb-breeding for the export trade special attention should be given to the selection of the parent ewe. Uneven, nondescript flocks cannot produce the uniform type of lamb the trade demands. The flock to be used for lamb production should consist of ewes of sound constitution, plain bodied, of big girth, flat withers, well-sprung ribs, and with plenty of depth through from shoulder to shoulder, presenting an appearance of symmetrical proportion and good conformation. Ewes which develop a good milk supply should be marked and those which fail in this respect culled out of the breeding flock.

From a good flock of Merino ewes, by judicious mating to pure-bred British Longwool rams—as recommended by the Department—can be produced good type half-bred ewes. These should be carefully culled and only the best retained for breeding purposes. All half-bred male progeny must be fattened and killed. Half-bred ewes, unlike pure bred, rarely, if ever, possess all that is characteristic of the parent flock. Generally, however, the ewes of the best conformation produce the best wool and the most desirable lambs.

All breeds of British Longwool rams, when mated to the Merino ewe, produce lambs which show characteristics distinguishing one cross from another. The Border-Leicester is a long-bodied lamb, good in conformation, rather leggy but with good hindquarters and shoulder, of big girth with deep and well-formed chest. The Lincoln lamb on the whole is the most regular in outline, with wide shoulders and deep wide chest. The Leicester is short of body with good hindquarters, but the forequarters and brisket are not so prominent as in the Border Leicester or Lincoln. The Romney Marsh is of large depth of body, shoulders wide, and the half-bred shows an improvement in the flesh on the back and ribs.

The use of the Romney Marsh ram is recommended in wet, marshy areas as this breed is very resistant to foot-rot and fluke.

By mating the selected half-bred ewes to the Southdown, Shropshire or Dorset Horn rams, the lambs produced will be earlier maturing than the half-bred. Given satisfactory conditions these lambs quickly develop and when dressed present the small-boned, plump, meaty carcase so necessary to meet the demand of the British consumer.

SELECTION OF BRITISH BREED RAMS.

Quality lambs can only be produced by mating the ewes to sires of pure blood. Rams of doubtful breeding must be avoided as an undesirable sire cannot be expected to throw satisfactory lambs. The following are the main points to be considered when judging the quality of sires of the various breeds:—

Border Leicester.—This is a rather leggy sheep with a long barrel-like body, of straight underline and has a stately carriage. This breed has given ample proof of its ability to thrive on a wide variety of pastures under differing climatic conditions, and in these respects it is, perhaps, a more versatile sheep than its long-woolled fellows.

Head.—Hornless, fairly long with a wide forehead, slightly Roman nose and dark nostrils.

Neck.—Of medium length, muscular, tapering evenly from the head and well set in at the shoulders.

Shoulder.—Wide and deep.

Wither.—Smooth and well rounded.

Chest.—Very full, prominent brisket, denoting plenty of heart room.

Back.—Very broad and straight and long with ribs well rounded.

Hindquarters.—Rump round and meaty, hips wide and level with moderate flank.

Legs.—Clean and covered with white hair, the hoofs are black.

Covering.—Good length of staple, showing character and lustre and an absence of bare skin. Average counts 46s. Merino-Border Leicester counts 50-56s.

Lincoln.—A large bodied sheep which grows the strongest and heaviest fleece of all British sheep.

Head.—Hornless, massive with deep jaw, clean white face, dark muzzle and a wide-covered forehead, prominent forelock.

Neck.—Of medium length, thick at the base and well set in at shoulders.

Shoulder.—Wide and large.

Chest.—Wide and fairly deep.

Wither.—Well arched and roomy.

Back.—Fleshy and fairly long with well sprung ribs.

Hindquarters.—Broad and fleshy, hips wide and level and full flank.

Legs.—Large boned with flat knees and strong black hoofs.

Covering.—Fleece shows character and lustre, is long in staple and very heavy. Average counts, 32s.-36s. Merino Cross counts, 46s.-50s.

English Leicester.—A rather leggy large-framed sheep which matures early and fattens rapidly.

Head.—Hornless, rather small, black muzzle, clean white face with cap of wool on forehead.

Neck.—Short in length, slightly arched and muscular.

Shoulder.—Broad, full and very fleshy.

Wither.—Level with back and fairly broad.

Back.—Fairly long and broad with a fleshy loin and cask-like ribs.

Hindquarters.—The rump is prominent, hips fairly wide and rather small flank.

Legs.—Long and wide apart with large black hoofs.

Covering.—Fleece of good length and lustrous and there is an absence of bare skin. Average counts, 40s. Merino Cross counts, 46s.-50s.

The Romney Marsh.—This is a large-framed sheep, and is very popular in wet, low-lying areas on account of its ability to resist foot-rot and fluke, which diseases are usually common to such localities.

Head.—Hornless, level between the ears, black muzzle, clean white face and a forelock of wool.

Neck.—Very short, strong and thick.

Shoulder.—Wide, large and fleshy.

Chest—Fairly wide and deep.

Wither.—Well rounded and level with the back.

Back.—Straight and broad, ribs well-sprung and loin flat and meaty.

Hindquarters.—Rump well rounded and heavy, hips wide apart and flank fairly broad.

Legs.—Short and big boned.

Covering.—Dense and of even quality. The cross with the Merino produces an excellent fleece. Average counts, 46s.-50s. Merino Cross, 56s.-58s.

Southdown.—A small-boned sheep which is very hardy and a good traveller. It yields mutton of excellent quality.

Head.—Hornless and level between the ears with a full, short face and short wool covering the forehead.

Neck.—Short, thick and fleshy, tapering slightly towards the head.

Shoulder.—Well set up, large and fleshy.

Chest.—Very deep and wide.

Wither.—Smooth and slightly arched.

Back.—Level and broad with a wide flat loin, well covered with firm flesh, ribs wide and well sprung.

Hindquarters.—Very deep and weighty with wide roomy hips and full flank.

Legs.—Rather short and wide apart, hoofs black.

Covering.—Of fine quality and densely covering the whole body down to the hocks and knees. Average counts, 54-56s.

Shropshire.—A medium-sized sheep noted for hardiness of constitution, tendency to early maturing, and adaptability of varying soils and climates.

Head.—Hornless, black muzzle, short face with broad forehead covered with wool.

Neck.—Rather short but thick and muscular.

Shoulder.—Large and fleshy.

Chest.—Very full and deep.

Wither.—Wide and rounded.

Back.—Broad and straight, loin wide, ribs well-sprung and very deep down the sides.

Hindquarters.—Rump well rounded and fleshy, hips broad and full flank.

Legs.—Short, stout and widely placed, covered to knees and hocks with dark soft hair, hoofs black.

Covering.—Dense and of medium strength. Dark hairs sometimes show in the fleece, but this is most undesirable. Average counts, 50s. to 56s.

Dorset Horn.—A large-bodied, hardy active sheep of vigorous constitution. Its prolificacy has brought the breed into great prominence, standing, perhaps, ahead of all others in this respect. Both ewes and rams have massive horns which resemble those of a Merino ram, but are larger and not so deeply corrugated.

Head.—Massive, spiral horns, top knot of wool, the face is long and very broad with a rounded bold muzzle and pink nose and lips.

Neck.—Short, thick and fleshy.

Shoulder.—Strong, plenty of depth and good forearm.

Chest.—Broad and deep, a prominent brisket, denoting plenty of heart room.

Back.—Long, broad and fleshy with good loin and well-sprung ribs.

Hindquarters.—The hips are wide and smooth and the rump well developed and rounded.

Legs.—Longer and stouter than those of the Southdown, giving a rather heavy appearance, and are covered with white hair.

Covering.—The wool is rather fine and fairly long in the staple and is chalky white in colour, being free from grey or black straggling fibres. Average counts, 50s.-56s.

EXPORT FAT LAMB PRODUCTION

THE FIRST STAGE
is the mating of

POOR MILKER

SLOW MATURING

THE MERINO EWE
with

HEAVY FLEECE

FOR GOOD PASTURES AND HEAVY LAND

THE LINCOLN
or

QUICK MATURING HEAVY BODY WEIGHT

HARDY SUITABLE SCANTY PASTURES

THE BORDER-LEICESTER
or

SHAPELY QUICK MATURING

FINE WOOL FOR GOOD PASTURES

THE ENGLISH-LEICESTER
or

GOOD FLEECE

FOR WET PASTURES RESISTS FOOT-ROT

THE ROMNEY MARSH

POINTS FOR LAMB-RAISERS

Mate the Merino with a Longwool Ram, a Border Leicester, English Leicester or Lincoln in dry districts, and with the Romney Marsh in wet districts to avoid foot-rot.

Mate the Merino Longwool Crossbred Ewe with a Southdown, and if not available, with a Dorset Horn or Shropshire Ram.

Use only Pure-bred Rams and only one breed in each flock.

Mate middle of November so that lambing finishes about end of May.

Feed well—especially at mating and after lambing. Guard against overfeeding pregnant Ewes.

Provide ample suitable phosphatic mineral licks for the mothers, especially during the summer. This is most important when the grass is dry.

Give Ewes every assistance at lambing time without undue handling. They should be gone through early morning and late at night.

Grow early feed to reduce hand-feeding as much as possible.

Mark lambs early and at least every three weeks.

Maintain the milk flow by feeding succulent fodders and thus prevent set-backs to the lambs and consequent loss of bloom and profit.

Market direct from mothers in even lots at 70-80 lbs. live weight.

Provide for as little delay in transit as possible. Do not overdrive. Do not catch lambs by the leg or grab the wool. Do not let the dog bite.

MATE EARLY.
FEED WELL.
MARK EARLY AND FREQUENTLY.
MARKET DIRECT FROM MOTHERS (before the grass dries off).
MINIMISE DELAY IN TRANSIT.
HANDLE CAREFULLY.

EXPORT FAT LAMB PRODUCTION

THE SECOND STAGE

is the production of

1st GRADE 28-36 lb.
2nd " 37-42 lb.
3rd " 43 lb & OVER
LIVE WT. 70-80 lb.

SHORT BODY
BROAD BACK
THICK FLANKS

THE EXPORT LAMB
by mating

BIG FRAME
GOOD MILKER

PROLIFIC
PROFITABLE
WOOL PRODUCER

THE LONGWOOL-MERINO XBRED MOTHER
with

MATURITY
12 - 14
WEEKS

VIGOROUS
PROLIFIC

THE DORSET HORN
OR

MATURITY
13 - 15
WEEKS

SHAPELY
PROLIFIC

THE SHROPSHIRE
OR

MATURITY
13 - 15
WEEKS

SHAPELY
PROLIFIC

THE SOUTHDOWN

GRAZING CROPS FOR LAMBING EWES.

I. Thomas, Superintendent of Wheat Farms.

With the decline in wheat and wool prices the prospects of lamb export have become more promising, and, in consequence, the wheat grower will be attracted in this direction.

One of the most important factors connected with the production of export lambs is a supply of succulent feed for the ewes when lambing. If advantage is to be taken of the most favourable period of the market for Western Australia the lambs intended for export should be dropped early in May. Under normal conditions prevailing at this time the natural feed in the Wheat Belt is dry, and may also be scanty, and green feed is not usually plentiful until late in June. These natural disadvantages can be overcome very largely by the growth and cultivation of those fodder crops suitable for our conditions: those adapted to Wheat Belt conditions and suitable for this purpose are oats, barley, and rye, and, to a lesser extent, rape and lucerne. Of these, for Western Australian conditions, oats should undoubtedly be given pride of place, for it is easily grown, is hardy, can be grazed at all stages, and even when it is nearly mature it will make excellent hay; when mature its grain is one of the best concentrates for sheep, cattle and horses. Even the oat stubble, after the grain has been removed, is of value and provides excellent pastures for sheep.

There are many varieties of oats, the best known of which are "Algerian," "Lachlan," "Guyra," "Ruakura," "Mulga," and "Burt's Early." Each of these is of special value under a certain set of conditions, and, for the particular purpose of supplying early grazing for the lambing flock "Mulga" and "Burt's Early" are at the head of the list, followed by the others in the following order, which is also the order of their maturity—"Guyra," "Lachlan," "Ruakura," and "Algerian." All are suitable for grazing, but "Mulga" and "Burt's Early," because of their quick habit of growth, will be fit for grazing a month or six weeks before "Algerian." The growing oat crop can be fed off several times, and then left for hay or to come to maturity for grain. It can be utilised to supplement by grazing the pasture if scanty during the late summer and autumn. Oats can be successfully grown on a variety of soils, from a poor clay or light sandy soil to rich clay or loam. The best results will, however, be obtained on a free-working, well-drained loam.

Barley, like oats, is an excellent early grazing crop. The most suitable early varieties are "Cape" and "Skinless," the former being the hardier. At one time barley, because of its quicker growth than the varieties of oats then in cultivation, was considered superior to oats for early grazing, but since the development of "Mulga" and "Burt's Early" oats it has this advantage no longer. On a wheat farm barley has the disadvantage that the grain from self-sown plants is likely to get mixed with the grain of the succeeding wheat crops, with a resulting "dockage," as millers do not like an admixture of barley with their wheat. Neither is barley nor rye a suitable change crop with wheat, as each is just as subject to "Take-all" as is that plant.

Rye is not nearly as suitable as oats for either hay or grain. It is, however, useful in that it is particularly hardy and grows well on soils altogether too poor for the production of fodder crops of either of the others. It, therefore, has a special value as a grazing crop on sandplain country.

The preparation of the soil is the same for oats, barley, or rye. For crops intended to be used for early grazing it is necessary that the land be fallowed so that they can be planted early to be in readiness for the early rains, and at the same time take advantage of the plant food made available, and also of the stored moisture conserved by the fallowing. The land should be ploughed during the preceding winter, and cultivated to destroy weed growth and maintain a mulch throughout the fallowing period. As the maintenance of the mulch is of the utmost importance, special attention must be paid to this feature of the fallowing process during the summer months. Usually the best implement for maintaining this mulch is a springtyned implement working at a depth of 2 to 2½ inches in the spring and shallower as seeding time is approached. After light rains, working with the harrows will probably be sufficient to restore the mulch. It must be remembered that the harrowed land sets more readily after subsequent showers.

The seed should be sown in the usual way with the seed drill at the rate of 1 bushel per acre, and, for early grazing purposes, at the end of March or the beginning of April. Superphosphate should be applied at the same time, and as liberally as circumstances will permit, say, from 80 to 150 lb. per acre, the higher rates being for the lighter land.

The sheep can be put on the crops at any time after there is sufficient for them to graze, but it is not advisable to pasture the sheep on the cultivated land when very wet.

As a grazing crop Rape has few equals under suitable conditions. It has a high feeding value very similar to Lucerne, is a rapid grower, can be fed off at any time, and, after being fed off, will grow again until the end of spring, when it comes into flower. A good crop will carry 10 ewes and their lambs to the acre, and fatten the latter to prime condition. In the early summer it is subject to aphis attack when, because of the smell, it becomes objectionable, though sheep will eat it readily. It will grow on a variety of soils, but on the lighter soils, particularly if unfallowed, it is apt to be dwarfed and unsatisfactory. It is not very drought resistant, and in many parts of this State it has not proved a very reliable crop. It is, therefore, advisable to sow it with oats so that, if the rape fails, the growth of the oats will ensure that the prepared land will not be wasted. In this State an early autumn start is essential, and this necessitates fallowing and early sowing in March. From 3 to 4 lb. per acre is quite sufficient when sown alone. When sown with oats 1½ lb. is suggested with 20 to 30 lb. of oats. Superphosphate at the usual rate should be applied.

When mixed with oats, rape can be sown through the seed box of the ordinary wheat drill, but when sown alone this is impossible without special seed cups, owing to the small size of the seed. In the absence of these special cups it can be mixed and sown with the superphosphate. The mixing should not be done for longer than 24 hours prior to sowing.

There is some danger of the stock becoming bloated when first turned on to rape. This risk is lessened when mixed with oats, and to lessen it, it is also the practice to mix white mustard with the rape seed in the proportion of 1 to 4. It is advisable to accustom the stock gradually to this crop, and never to put them on it for the first few times when hungry and empty.

Lucerne, except in the extreme Southern part, cannot be grown readily and successfully other than in favoured locations. Because of its semi-permanent character once established it is always ready to take advantage of every shower and provide green picking or luxuriant grazing or hay according to the extent

of the rain. Because of this, coupled with its high feeding value, it is the "Queen of Fodder Plants." Despite its lack of suitability under general conditions it is worth while to search for any special location on the holding to see if, with care, five to 10 acres, or even less, cannot be grown. Briefly, the requirements for success are that the land be well prepared, sometimes in advance of sowing, and freed from weed growth. In its young state weeds are so detrimental to success that the necessity for controlling them will determine when this crop be sown. If the conditions are such that the weeds can be controlled with autumn sowing, then this is preferable, particularly in warm locations. Under cold or wet conditions spring sowing is advisable, and also when the ground is very weedy, as this affords an opportunity for the weed seeds to germinate, and the resulting plant to be destroyed. The rate of seeding for grazing purposes is from 2½ to 5 lb. per acre, and the depth of sowing about half an inch in the autumn and one inch in the spring. A liberal dressing of superphosphate should be applied at the same time. Those interested in the cultivation of lucerne will find it very fully dealt with in Bulletin No. 149.

The facilities which are available for cultivation on the wheat farm are of great assistance in connection with the production of grazing crops for the lambing ewe. The general farming practice will, however, need to be modified and organised to meet the altered requirements. The area devoted to the growing of wheat for grain will require to be less and the cropping rotation will require to provide for the inclusion of the fodder crops most suitable for particular conditions. It will be an added advantage if the fodder crops are such that, in addition to providing for early green feed for the lambing ewes, they will also help to increase the yield per acre of the wheat crop. Oats and rape are useful in this connection in that these crops are practically immune to the diseases "Take-all" and "Flag Smut," which are present throughout the Wheat Belt, and in some districts have assumed such serious proportions. The only satisfactory control measures for these diseases are those which provide for the starving out of the disease by keeping the ground free of crops susceptible to it. This, however, does not prohibit the planting of such crops as are immune or resistant to them. Crops like oats and rape are immune, and are, therefore, of special value to the wheat grower, in that by their aid the disease is controlled by cropping methods which are profitable and of benefit to the succeeding crop. Barley is not useful in this respect as it is also susceptible to "Take-all" and some other wheat diseases.

Rape has an additional advantage in that it has a strong deep root system which enables it to utilise the plant food in the subsoil, much of which, after the plant above the surface has been fed off, is made available to succeeding crops. Its deep tap root also acts as a natural subsoiler and improves the drainage of the soils in which it is growing.

The growing of grazing crops is, therefore, of benefit to the wheat grower in two ways—they assist him to rear and market his lambs at the most profitable time, and also enable him to control wheat diseases, and thus indirectly produce better yields and reduce costs of production.

THE EXPORT LAMB.

THE LESSONS OF THE EXPERIMENTS.

Geo. L. Sutton,
Director of Agriculture.

With an enormous unsaleable surplus of Merino sheep, it is inevitable that the agriculturalist, with ability to change the character of his sheep husbandry without serious difficulty, will give consideration to the production of lambs for export, and with decided advantage to his annual income. Though it may require more care than is given to the average Merino flock, probably no branch of the sheep industry furnishes such quick and profitable returns as that of lamb raising. A well-grown lamb four to five months old is frequently worth more than a wether several months older, and the profits from lambs are not unlikely to be greater than those of a whole year from even the most profitable wool types. Lamb raising, too, is eminently suited to the conditions of our agricultural areas, in that it enables the maximum number of stock to be carried during our mild winter, when the feed is most succulent and most abundant, and enables the numbers to be reduced to the minimum when our pastures are driest and scantiest.

In order that the farmers in this State may take the greatest advantage of the facilities which exist for fat lamb export it is essential that our breeders should realise what are the requirements of our customers and satisfy these requirements as well as our conditions will permit. In order to prevent financial loss and waste effort it is also necessary to ascertain and be guided by the information obtained as the result of systematic experiments and gained by hard-won practical experience.

The British market is the only export market of any magnitude open to West Australian lamb raisers. As this market is well supplied, it is imperative that those who desire to obtain satisfactory returns from it must comply with its requirements, even though these latter may be regarded as fastidious. The market of the United Kingdom demands a small lamb—one dressing not more than 42 lbs. and preferably ranging from 28 to 36 lbs. A description of the best export lamb may be set out as follows:—The carcase should be compact and symmetrical, and its general appearance light and bright rather than dark or yellowish; it must also be sappy and fresh and not dry, evenly coated with flesh, but not over fat; the fat should be white and well distributed throughout the body, and showing clearly under the tissues, so that the flesh beneath is more or less completely hidden. Particularly must this be the case on the hind-quarters and points of the withers. This covering of fat is technically known as the "selvedge," and gives to the carcase what is known as the "bloom" or "finish." The body should be well-rounded with a broad back, full in the buttocks, producing a U-shaped arch rather than the V-shaped lankiness. The shoulders and flanks should also be full, with light bone, thick neck and meat down to the knees and hocks.

These characteristics resemble those of the best British mutton breeds, of which the Southdown is probably the leading type. The Merino, valuable as it has been to Australia, cannot conform to these requirements. Its shape is too angular and its meat too dark.

Definite information regarding the unsuitability of the Merino for export purposes is furnished by the experiments conducted at the Roseworthy Agricultural College,* Gawler, South Australia. These showed that not only did such a lamb mature too slowly, but that 18.33 per cent. failed to reach even the third-quality standard for the export lamb. Of those which reached the export standard, 40 per cent. were classed as third-quality grade; 33⅓ per cent. as second-quality only, and 8.34 per cent. as first-quality.

Unsatisfactory, however, as is the Merino lamb, obviously the Merino ewe, because it is the sheep of Australia, must of necessity be the foundation from which a suitable export lamb will be secured. To achieve this end it must be produced by improving the carcase qualities of the Merino by mating the latter with a ram of one of the British breeds which are at the other end of the scale with regard to quality of carcase. Numerous British breeds have been evolved during the course of time to suit particular districts in Great Britain, and each of these has a special value for a particular district in that country. Many of the breeds have been tried in Australia, and from the results of these trials it is possible to say definitely that the number of breeds necessary for our purposes can be reduced to a selection from amongst seven. These seven breeds are divided into two groups, known respectively as the Longwool group and the Shortwool or Downs group. In the Downs group are the Southdown, Shropshire and Dorset Horn, and the Longwool group includes the Border Leicester, English Leicester, Lincoln, and Romney Marsh. Both groups produce carcases of excellent quality. The Longwool group is a dual purpose type producing more wool than those of the Downs type.

THE FIRST SERIES OF THE EXPERIMENTS.

One series of the Roseworthy experiments, already referred to, and which are informative and comprehensive, furnish valuable information obtained from mating the Merino ewe with rams of the different breeds already mentioned, and also with the Merino ram.

In connection with the management of the Roseworthy College experimental flocks, the investigators state: "No special care beyond what might reasonably be expected to be given to any farm breeding ewes has been bestowed upon the experimental flocks. The same consideration in respect to grazing, change of pasture, and open or close stocking has, as far as human judgment will permit, been shown to all, every effort being made to offer equal opportunities all round. Hand-feeding has not been resorted to in any instance, reliance being placed wholly on field grazing and systematic changing of flocks as frequently as was deemed desirable. At mating time—middle of November—the ewes were drafted into flocks according to the breed of rams to which they were to be bred. Ewes of all kinds due to be mated with the Dorset Horn, for instance, were put together during the tupping season, and in this way each breed was given an equal opportunity of demonstrating its capacity to yield a high percentage of lambs. The sires were young and vigorous, and the proportion used in each flock was approximately one to forty ewes, or 2½ per cent. Prior to lambing the ewes were carefully drafted into their respective breeds, and were regularly tended throughout the yeaning period -latter half of April to early June—with a view to rendering timely help to either ewes or lambs in necessitous cases. The rams were introduced towards the end of November and were withdrawn about seven weeks later."

* "An Investigation into Certain Aspects of Fat Lamb Production on Agricultural Holdings" (1928)—W. J. Colebatch, B.Sc., M.R.V.S., Principal, and R. C. Scott, R.D.A.

The results of the experiment dealing with the first aspect of this problem, viz., the influence of the different rams upon the fertility of the Merino ewes, are set out in Table 1 hereunder. The percentages given of the lambs dropped, tailed and marketed are those of the ewes mated, and not of the ewes present at lambing time; no account is taken of the ewes lost between mating and lambing:—

TABLE 1.

Influence of the Ram, on the Fertility of Merino Ewes, and on Lambing Difficulties.

Group.	Lambs Dropped.	Lambs lost, lambing difficulties.	Lambs Tailed.	Lambs Marketed.
Longwool group:	%	%	%	%
Lincoln	102·74	12·66	89·73	85·38
English Leicester	92·95	7·48	86·00	83·08
Border Leicester	92·95	4·00	89·23	89·23
Romney Marsh	83·01	13·76	71·59	67·69
Downs group:				
Dorset Horn	93·75	16·44	78·34	76·13
Shropshire	95·11	15·89	80·00	78·69
Southdown	91·61	9·04	83·33	81·97

Commenting upon these results the investigators state: "Of the rams mated with Merino ewes the Lincoln gave the highest increase and the Romney Marsh the lowest, but the differences in all other classes were comparatively small." . . . . . "Under skilful management the losses occurring after the lambs are tailed will, as a rule, be comparatively small, but the mortality figures for the period between lambing and tailing are relatively high, and this will be understood when it is explained that the lambing figures include all lambs born either dead or alive, as well as unborn lambs discovered 'in utero' on post-mortem examination." . . . . "It is interesting to study the influence of the various rams on the rate of mortality in the lambing fields. The heaviest losses occurred when the Merino ewe was mated with the Dorset Horn, the younger ewes finding difficulty in giving birth to lambs inheriting the big shoulders of their sires. To this cause must be attributed the comparatively low production of marketable lambs from the Merino x Dorset Horn cross. Heavy losses at lambing were also experienced when the Merino ewe was crossed with the Shropshire, Romney Marsh and Lincoln rams, the chief cause in these cases being the size, and particularly the breadth of the head. With the Southdown, English Leicester and Border Leicester sires, however, very little trouble ensued."

The results show that, in order to reduce lambing losses when Merino ewes are mated with the under-mentioned breeds, preference should be given in the following order:—

	Lambs lost between lambing and tailing.
	%
Border Leicester	4·0
English Leicester	7·48
Southdown	9·04
Lincoln	12·66
Romney Marsh	13·76
Shropshire	15·89
Dorset Horn	16·44

GROWTH AND DEVELOPMENT OF LAMBS.

In considering this phase the investigators state: "It is important to realise that the whole of the lambs marketed from the experimental flocks have been fattened off their mothers. No artificial feeding of any kind was practised, and, consequently, the data submitted has reference only to flocks kept on natural pasture under dry farm conditions." The practice was to take the weight of the newly born lambs and then to conduct fortnightly weighings commencing when the lambs were about 12 weeks old.

As the result of several season's trials, the following average weights were adopted as representing those of newly-born lambs:—

Ewe.	Ram.	Average weight at birth.
		lbs.
Merino	Merino	8
Merino	Longwool ram—	
	Lincoln	10
	English Leicester	
	Border Leicester	
	Romney Marsh	
Merino	Shortwool Ram—	
	Dorset Horn	9
	Shropshire	8½
	Southdown	

The systematic fortnightly weighings were commenced during the first week in August and continued until the final draft of lambs was marketed, but the subsequent weighings after the period of 14 weeks had elapsed applied to dwindling numbers according to the rate at which they were drafted out for marketing. The table hereunder shows the results of the fortnightly weighings from tailing onwards:—

TABLE 2.

Average Rate of Increase per day from Tailing onwards.

Ewe.	Ram.	Tailing to 12 weeks.	12 weeks to 14 weeks.	14 weeks to 16 weeks.	16 weeks to 18 weeks.	18 weeks to 20 weeks.	Average Increase per day.
		lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Merino	Merino	0·40	0·48	0·41	0·32	0·19	0·38
Merino	Lincoln	0·44	0·55	0·58	0·44	0·41	0·47
	English Leicester	0·44	0·54	0·59	0·50	0·39	0·47
	Border Leicester	0·44	0·47	0·54	0·62	0·43	0·48
	Romney Marsh	0·46	0·51	0·48	0·58	0·25	0·46
Merino	Dorset Horn	0·52	0·53	0·72	0·57	0·30	0·53
	Shropshire	0·45	0·51	0·56	0·51	0·33	0·46
	Southdown	0·46	0·52	0·57	0·53	0·34	0·48

The details in Table 3 hereunder are interesting in showing the rate at which the lambs of the different crosses were marketed:—

TABLE 3

Rate of Maturity.

Ewe.	Ram.	Percentage Lambs marketed by—						
		Aug. 21st.	Sept. 4th.	Sept. 18th.	Oct., 2nd.	Oct., 16th.	Oct., 30th.	Nov., 13th.
Merino ...	Merino	0·00	14·00	30·00	30·00	40·00	40·00	100·00
Merino ...	Lincoln	3·70	16·67	31·48	33·33	50·00	85·19	100·00
	English Leicester	0·00	28·30	43·40	58·49	69·81	88·68	100·00
	Border Leicester	3·23	35·48	53·23	72·58	87·10	95·16	100·00
	Romney Marsh ...	2·63	26·32	42·11	55·26	76·32	78·95	100·00
Merino ...	Dorset Horn ...	5·77	59·62	73·08	76·92	94·23	98·08	100·00
	Shropshire ...	0·00	20·83	35·42	35·42	58·33	79·17	100·00
	Southdown ...	0·00	24·49	36·73	48·92	77·55	91·84	100·00

The only outstanding feature of these results is the evidence of the quicker maturing rate of the lambs sired by the Dorset Horn ram, this cross being the quickest to mature followed closely by the Border Leicester. At the middle period of the marketing, viz., October 2nd, the percentage of the total number of lambs marketed was—

Sire.	Percentage lambs marketed middle of marketing period, 2nd October.
Dorset Horn	77
Border Leicester	73
English Leicester	58
Romney Marsh	55
Southdown	49
Shropshire	35
Lincoln	33
Merino	30

The results are complicated owing to the fact that the lambing was spread over a period of seven weeks. They, however, provide useful data for calculating the age at which lambs of the different breeds can be expected to reach any particular live weight desired.

LOSS FROM FARM TO ABATTOIRS.

The Roseworthy Agricultural College is situated comparatively close to the Adelaide saleyards, and stock for sale are not usually trucked until the afternoon of the day preceding the sale. A period of about twenty-four hours—a reasonable one to allow for the time which elapsed—is allowed between the moving and travelling of the lambs to the rail and time of sale, with a shorter period between the

time of sale and slaughter. The losses in the weight of the lambs from the time they left the farm until slaughtered and dressed are set out in the table hereunder:—

TABLE 4.

LIVE AND CARCASE WEIGHTS OF MERINO AND CROSSBRED LAMBS.

Sire of lamb.	Farm weight.	Sale-yard weight.	Loss.	Pre-slaughter weight.	Dressed weight.	Shrinkage in dressing.	Loss, farm to hooks.
	lb.	lb.	%	lb.	lb.	%	%
Merino	80·97	75·87	6·30	73·30	33·07	54·88	59·16
Longwool group—							
Lincoln	84·62	78·97	6·68	76·77	36·45	52·52	56·93
English Leicester ...	84·59	78·96	6·66	77·05	37·74	51·02	55·38
Border Leicester ...	82·18	77·96	5·14	76·24	37·19	51·22	54·75
Romney Marsh ...	85·85	80·77	5·92	78·36	37·84	51·71	55·92
Downs group—							
Dorset Horn	81·49	76·90	5·63	74·95	37·38	50·13	54·13
Shropshire	80·83	75·22	6·94	73·15	35·20	51·88	56·45
Southdown	78·76	74·14	5·87	72·52	37·27	48·61	52·68

From the above it will be seen that the Southdown cross travelled well and "killed" best, followed closely by the Dorset Horn and Border Leicester in that order. The results are very informative and useful for guidance, but it must be remembered that the actual figures would vary in accordance with the location of the farm and the district in which it is situated. Such factors as distance from the rail, distance of the siding from the export works, weather conditions during loading and transport would affect the actual shrinkage, particularly from farm to sale-yards; though probably the relative shrinkage on dressing between the different crosses would not be affected.

QUALITY OF CARCASES.

The experimental lambs were slaughtered and graded at the Government Produce Depot, Adelaide. The results are shown in Table 5 hereunder:—

TABLE 5.

QUALITY OF CARCASES.

Sire.	1st grade.	2nd grade.	3rd grade.	Reject.
	%	%	%	%
Merino	8·34	33·33	40·00	18·33
Longwool group—				
Lincoln	50·00	35·19	14·81	...
English Leicester	77·36	18·87	3·77	...
Border Leicester	74·19	24·19	1·62	...
Romney Marsh	31·58	52·63	15·79	...
Downs group—				
Dorset Horn	63·46	36·54	...	...
Shropshire	43·75	47·92	8·33	...
Southdown	91·84	8·16	...	...

The striking feature of these results is the improvement in carcase quality for export purposes which follows as the result of mating the Merino with the British breeds, particularly with the Southdown. The excellent showing of the English Leicester and Border Leicester crosses is also worthy of note.

THE FINANCIAL RETURNS.

In order to assess the returns obtained from the different crosses, it was decided to base the values upon the prices which had been obtained in London for Australian frozen lamb during the two years previously (1924 and 1925). It was realised that these would fluctuate between fairly wide limits, but, in order to make comparisons, it was essential to fix a definite basis, as the experimental consignments were too small to be sold in separate lots and the actual returns could, therefore, not be used. The following schedule was decided upon after consultation with competent authorities:—

SCALE OF VALUES.

Quality.	Grade.		London price, per lb.
	No.	Weight in lbs.	s. d.
First	2	28–36	0 10
Do.	8	37–42	0 9
Do.	4	43 and over	0 8½
Second	2	28–36	0 9¼
Do.	8	37–42	0 8½
Do.	4	43 and over	0 8
Third	...	All weights	0 8¼
Rejects	...	do.	0 5

Based upon these rates and the percentage of lambs marketed, Table 6 hereunder has been prepared with the different crosses arranged in order according to the calculated return per flock of 100 ewes, and commencing with the cross giving the greatest return:—

TABLE 6.

THE ANNUAL GROSS RETURNS PER 100 EWES FOR EXPORT LAMBS FROM MERINO EWES.

Sire.	Lambs marketed.	Value, Lamb carcases.	Value, Lamb pelts.	Total Value, Lambs.
	%	£ s. d.	£ s. d.	£ s. d.
Border Leicester	89·23	128 12 10	28 5 1	156 17 11
English Leicester	83·08	119 5 6	29 15 6	149 10 11
Lincoln	85·38	117 0 10	28 9 2	145 10 0
Southdown	81·97	118 3 6	23 4 6	141 8 0
Dorset Horn	76·13	108 3 4	22 11 5	130 14 9
Shropshire	78·69	107 4 4	23 5 7	130 9 11
Romney Marsh	67·69	93 18 5	23 8 2	117 6 7
Merino	78·42	84 19 1	28 8 7	113 7 8

It will be seen from these results that of the English mutton breeds under trial the **Border Leicester** proved the most profitable to mate with the Merino. In addition, the results of other phases of this experiment previously given also show that, compared with the other rams mated with the Merino ewe, **the Border Leicester cross—**

Was freer from lambing troubles;

Had the greatest percentage of lambs tailed;

In common with others of the Longwool group, produced the lamb of greatest weight at birth;

Ranked second to the Dorset Horn in earliness of maturity;

Travelled well and "killed" well; and

Ranked highly in the production of first-grade carcases.

As the climatic conditions which obtain at Roseworthy Agricultural College farm are very similar to those which obtain over a very large portion of the Wheat Belt, these experiments indicate in no uncertain manner that, with the Merino ewe as the mother, the Border Leicester ram should be used as the sire. This is in accord wtih the practice in New Zealand, where the related English Leicester has been used for mating with the Merino to produce the "Canterbury" lambs, which have earned such an enviable reputation for that Dominion.

THE SECOND SERIES OF THE EXPERIMENTS.

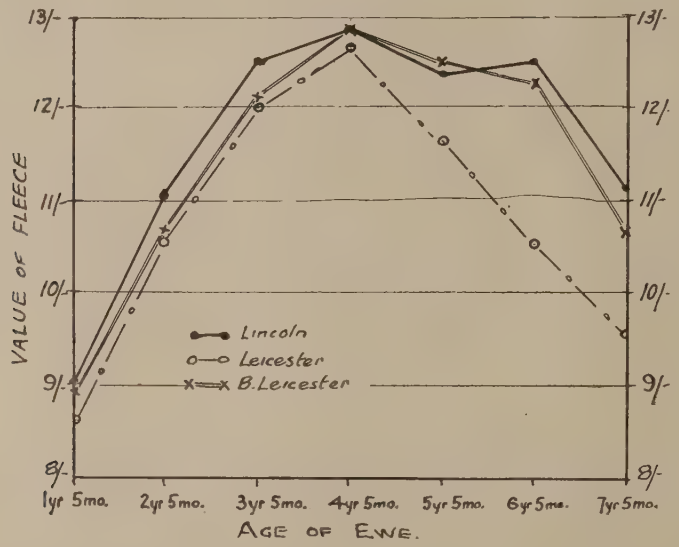
Because of the specialisation in wool which has been practised in Western Australia in common with other parts of Australia, the predominant type of ewe available for lamb production is the Merino, and, in consequence, at present and for some years to come, it is this ewe that will be used. The Merino ewe, however, is not very suitable for the purpose, its progeny is slow-maturing, and, because of this characteristic, the milk supply of the ewe is comparatively light and, though sufficient for its own lamb, is not sufficient to properly satisfy the needs of a vigorous and quickly maturing crossbred lamb sired by one of the British breeds. For this purpose a ewe of a British breed would undoubtedly be the most suitable, but there are not sufficient in Australia to meet the needs of our lamb raisers. Further, it must not be forgotten that the dam of the export lamb has to be carried over the whole year, during which time it is producing a fleece. It is essential, therefore, that it should be a good wool producer. The wool it carries should be of the most valuable kind and the largest quantity possible under the circumstances. Ewes of the Shortwool or Downs type are very much inferior in this respect to the Merino, which stands supreme, and are, therefore, unsuitable.

Though the Merino is essentially the predominant wool type, it is not the only good wool type, and the experiments conducted at Roseworthy in South Australia, and at Bathurst, Cowra and Wagga, in New South Wales, have shown that, as the result of mating British rams of the Longwool type with the Merino, a crossbred sheep is produced from which a very profitable fleece is obtained.

The experiments in New South Wales were conducted at Cowra and Wagga in typical wheat-growing country and similar to that in Western Australia. The breds experimented with were Lincoln, English Leicester and Border Leicester. The Romney Marsh was not included as the conditions were drier than were considered

suitable to bring out the best characteristics of this breed. With regard to fleece produced, the Lincoln consistently gave heavier fleece weights at all ages from hogget to full-mouth. The value of the fleece was also greater, but only slightly so. These results are graphically shown in Diagram A.

DIAGRAM "A."



At the Roseworthy Agricultural College the Romney Marsh was included in the experiments with the other three breeds, and comparisons made of the wool return from each cross and also from Merino ewes. The values in each were based upon the following scale of prices, which were the ruling rates on the Adelaide market for farm clips at that time, and were as under:—

Class.	Merino.	Crossbred.
	d.	d.
AA Fleece	21½	20
A Fleece	18¾	16⅛
BB Fleece	17¾	16
AA Pieces	18½	11½
A Pieces	12½	6
Pieces	...	3
Bellies	14	7
Locks and stains	3	3

The wool yields of the various crossbred and Merino flocks for the period 1924-26, and the average values calculated on the above scale, are set out in Table 7 hereunder:

TABLE 7.

Wool Returns from Merino and Longwool × Merino Ewes.

Ewe.	Number of fleeces.	Average fleece.	Total value.	Average value per head.	Gross Wool returns per 100 Ewes.
		lbs.	£ s. d.	s. d.	£ s. d.
Merino...	330	11·00	280 14 4	17 0	85 0 0
Lincoln-Merino	94	12·00	69 1 8	14 8	73 6 8
English Leicester-Merino ...	89	10·50	63 16 0	14 4	71 13 4
Border Leicester-Merino ...	92	10·75	64 13 0	14 1	70 8 4
Romney Marsh-Merino ...	89	11·00	63 5 2	14 3	71 5 0

With high prices ruling the monetary returns from the College Merinos were considerably greater than from the crossbreds. With lower rates ruling for all classes of wool the ratio then obtaining (1926) would not obtain now in 1931. Further, it is doubtful whether, under any conditions, the relative financial results would be secured from the average farm Merinos, as ordinarily they are purchased when aged for lamb breeding, and the crossbreds, if not bred on the farm, are purchased when young.

LAMBS FROM MERINO AND LONGWOOL CROSSBRED EWES BY THE SAME SIRE,

"TIPPERARY," 24th AUGUST, 1931.

Sire—Dorset Horn.

Weights 6th August, 1931: Merino Ewe, 47 lbs.; Crossbred Ewe, 83 lbs.

The value of the wool produced by each of the crossbred flocks was of similar value, and, for practical purposes, they may be considered equal in this respect. It is expected this would obtain irrespective of normal variations in the ruling rates for wool. The fact that the Longwool-Merino crossbred is a profitable wool producer gives an added advantage to such crosses in that, should adverse conditions prevent the progeny being sold as lambs, they can be carried over with profit to the hogget stage, or even until older.

Experiments to ascertain the wool returns from the Merino mated with sires of the Downs or Shortwool type were considered unnecessary and unwarranted, as such crosses are known to be unprofitable wool producers.

Though the crossbreds were not as profitable for wool production as the College Merinos, and may not even be as profitable as the average Merino ewe available for lamb production, they were sufficiently profitable to be considered as potential mothers for mating with rams of the Downs type, and were used in a second series of experiments carried out on identical lines to those of the first series already discussed and in which the Merino ewe was the mother.

The influence of the ram used on the fertility of the various Longwool Merino ewes, and on their lambing difficulties, when mated with rams of the different Downs breeds, is shown in Table 8 hereunder:—

TABLE 8.

THE INFLUENCE OF THE RAM ON THE FERTILITY OF THE EWES AND ON LAMBING DIFFICULTIES.

Ram.	Ewe.	Lambs dropped.	Lambs lost, lambing difficulties.	Lambs tailed.	Lambs marketed.
		%	%	%	%
Dorset Horn	Lincoln-Merino	105·00	6·34	98·34	96·72
	English Leicester-Merino	98·86	8·67	90·29	88·71
	Border Leicester-Merino	112·71	2·87	109·48	108·06
	Romney Marsh-Merino	100·00	6·33	93·67	90·32
	Merino...	93·75	16·44	78·34	76·13
Shropshire	Lincoln-Merino	96·89	3·45	93·55	93·44
	English Leicester Merino	85·11	5·75	80·22	75·49
	Border Leicester-Merino	107·80	4·29	103·18	100·00
	Romney Marsh-Merino	85·00	11·76	75·00	73·85
	Merino	95·11	15·89	80·00	78·69
Southdown	Lincoln-Merino ...	98·44	1·69	96·78	95·16
	English Leicester-Merino	106·67	3·07	103·39	98·36
	Border Leicester-Merino	112·56	3·80	108·28	108·20
	Romney Marsh-Merino	113·18	7·18	105·05	103·28
	Merino	91·61	9·04	83·33	81·97

The effect of using any of the Longwool-Merino mothers is to reduce the extent of the mortality found when Merino ewes are used. The Border Leicester Merino ewe is undoubtedly the most prolific, and holds a favourable position with regard to freedom from lambing troubles.

The experience at "Koobabbie," Coorow, supports the results regarding the fertility of the Border Leicester-Merino ewe. This season (1930-31) the number of ewes mated was 1,051, and despite the fact that foxes were prevalent, and an unknown number of lambs taken, the number marked was 1,056 or 100.5 per cent.

It is very generally believed that ewes mated with a Dorset Horn ram are more prolific than those mated with a Southdown or Shropshire. This opinion is, however, not confirmed by the results of the Roseworthy experiments nor by the results with the experimental flocks at Tipperary this season. These latter rather suggest that any difference in the fertility of the ewes is due largely to the individuality of the ram and or special conditions at time of mating. Dorset Horn, Shropshire and Southdown rams were mated with Longwool-Merino crossbred ewes and also Merino ewes. The ewes were aged and the crossbreds mainly Lincoln-Merino crosses. The ewes were divided into three flocks, each containing 67 crossbreds and 26 Merinos for mating respectively with Dorset Horn, Shropshire and Southdown rams—two rams to each flock of 93 ewes. Between mating and the commencement of lambing 10 ewes died, and as it was impossible to determine to which of the flocks any of these belonged, it was assumed that three from each flock had died, thus reducing the number of ewes to 90 in each. The lambing results are as follow:—

Breed of Ram.	No. of lambs from—		Total.	Percentage.
	Crossbred Ewes.	Merino Ewes.		
Shropshire	51	23	74	82
Southdown	54	18	72	80
Dorset Horn	51	20	71	79

These for experimental purposes are close enough to be regarded as equal.

It will be noted that, in connection with lambing losses, the Dorset Horn shows to the least advantage amongst the rams, and the Romney Marsh-Merino crossbred ewe amongst the ewes. This is in accordance with the experience already recorded when these breeds were mated to Merino ewes. In this connection it must be realised that the Romney Marsh has a special place of its own. As the result of selection over centuries in the marshes of Kent the Romney breed possesses an inherent resistance to footrot, in consequence of which it should be used in wet districts where that disease is troublesome.

GROWTH AND DEVELOPMENT OF LAMBS.

It was found that the effect of substituting the crossbred for the Merino mother was to increase the weight of the lamb at birth by 1½ lbs., the relative advantage of the Dorset Horn over the Shropshire and Southdown being maintained, the respective weights of the lambs at birth being—

Ewe.	Sire.		
	Dorset Horn.	Shropshire.	Southdown.
	lbs.	lbs.	lbs.
Merino	9	8½	8½
Lincoln-Merino	10½	10	10
English Leicester-Merino			
Border Leicester-Merino			
Romney Marsh-Merino			

The results of the periodical weighings are set out in Table 9 hereunder:—

TABLE 9.

THE AVERAGE RATE OF INCREASE PER DAY FROM TAILING ONWARDS.

Ram.	Ewe.	Tailing to 12 weeks.	12 weeks to 14 weeks.	14 weeks to 16 weeks.	16 weeks to 18 weeks.	18 weeks to 20 weeks.	Average increase per day.
		lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Dorset Horn	Lincoln-Merino ...	0·54	0·67	0·69	0·60	0·46	0·57
	English Leicester-Merino... ...	0·59	0·67	0·65	0·62	0·49	0·60
	Border Leicester-Merino... ...	0·59	0·64	0·72	0·54	0·35	0·58
	Romney Marsh-Merino... ...	0·54	0·65	0·72	0·48	0·31	0·54
	Merino	0·52	0·53	0·72	0·57	0·30	0·53
Shropshire ...	Lincoln-Merino ...	0·47	0·70	0·56	0·49	0·41	0·51
	English Leicester-Merino... ...	0·49	0·60	0·67	0·59	0·39	0·53
	Border Leicester-Merino... ...	0·53	0·63	0·66	0·52	0·43	0·56
	Romney Marsh-Merino... ...	0·51	0·56	0·64	0·50	0·34	0·51
	Merino	0·45	0·51	0·56	0·51	0·33	0·46
Southdown ...	Lincoln-Merino ...	0·44	0·64	0·56	0·52	0·38	0·48
	English Leicester-Merino... ...	0·49	0·76	0·66	0·49	0·41	0·54
	Border Leicester-Merino... ...	0·52	0·61	0·68	0·51	0·42	0·54
	Romney Marsh-Merino... ...	0·53	0·58	0·63	0·47	0·35	0·52
	Merino	0·46	0·52	0·57	0·53	0·34	0·48

It will be seen that the lambs with the Crossbred mothers generally make a decidedly better daily gain than those with Merino mothers, and, in consequence, they will be ready for the market earlier. This is reflected in Table 10 hereunder:—

TABLE 10.

RATE OF MATURITY.

Ram.	Ewe.	Percentage of Lambs marketed by—						
		Aug. 21st.	Sept., 4th.	Sept., 18th.	Oct., 2nd.	Oct., 16th.	Oct., 30th.	Nov., 13th.
Dorset Horn	Lincoln-Merino ...	22·03	54·24	72·88	81·36	96·61	100·00	100·00
	English Leicester-Merino... ...	30·91	80·00	89·09	89·08	98·18	98·18	100·00
	Border Leicester-Merino... ...	28·36	76·12	85·07	91·04	98·51	98·51	100·00
	Romney Marsh-Merino... ...	19·64	55·36	71·43	80·36	92·86	98·21	100·00
	Merino	5·77	59·62	73·08	76·92	94·23	98·08	100·00
Shropshire ...	Lincoln-Merino ...	8·77	22·81	49·12	56·14	75·41	80·70	100·00
	English Leicester-Merino... ...	11·63	27·91	48·84	62·79	83·72	95·35	100·00
	Border Leicester-Merino... ...	6·56	40·98	62·30	77·05	93·44	93·44	100·00
	Romney Marsh-Merino... ...	14·29	38·10	57·14	66·67	85·71	88·10	100·00
	Merino	0·00	20·83	35·42	35·42	58·33	79·17	100·00
Southdown	Lincoln-Merino ...	8·20	19·67	39·34	47·54	75·41	83·61	100·00
	English Leicester-Merino... ...	5·00	20·00	40·00	50·00	78·33	88·33	100·00
	Border Leicester-Merino... ...	1·52	31·82	56·06	77·27	90·91	96·97	100·00
	Romney Marsh-Merino... ...	15·87	46·03	57·14	63·49	84·13	87·30	100·00
	Merino	0·00	24·49	36·73	48·92	77·55	91·84	100·00

From a comparison of these results it will be seen that the effect of using a crossbred ewe is to expedite the date of marketing by from a fortnight to three weeks. On October 2nd—the middle of the marketing period—77 per cent. of the Dorset Horn-Merino lambs were ready for market, whilst a fortnight earlier 85 per cent. of the Dorset Horn-Border Leicester-Merino lambs were ready. On the same date 35 per cent. of the Shropshire-Merino cross were ready, but four weeks earlier 41 per cent. of the Shropshire-Border Leicester-Merino cross were ready. Similarly, there were 49 per cent. of the Southdown-Merinos ready, and a fortnight earlier 56 per cent. of the Southdown-Border Leicester-Merinos were ready.

Taking the middle of the marketing period again it will be seen that the greatest percentage of lambs was marketed from Border Leicester-Merino ewes, irrespective of what ram was used. The precocity of the Border Leicester-Merino ewe is explained by the results of the New South Wales experiments at Cowra and Wagga from 1909 onwards. The results were consistent and conclusive in showing that

lambs from Merino ewes and sired by the Border Leicester rams were always heavier than lambs and sheep of the same age from similar ewes sired by either Lincoln or English Leicester rams.

The Dorset Horn, as with the Merino ewes, was again the most precocious, and when mated with the Border Leicester-Merino produced 91 per cent. by the middle of the marketing period, compared with 77 per cent. for the Shropshire and Southdown.

Further evidence regarding the earliness of maturity due to the use of the longwool crossbred ewe, and also of the Dorset ram, is furnished by the experience of Mr. S. E. Roblack of "Kenbabbin," Coorow, and the experiments carried out on the property of Mr. W. G. Burges, "Tipperary," Barrys Siding. Mr. Roblack finds that his Dorset Horn-Border Leicester-Merino lambs are ready for market about a fortnight earlier than lambs by Southdown rams from ewes of the same cross.

LAMBS FROM MERINO AND LONGWOOL CROSSBRED EWES
BY THE SAME SIRE,
"TIPPERARY," 24th AUGUST, 1931.

Sire—Southdown.

Weights 6th August, 1931: Merino Ewe, 53 lbs.; Crossbred Ewe, 80 lbs.

When the first seasonal batch of experimental lambs was being selected for marketing at "Tipperary" on 24th August of this year, it was found that, of the progeny of Merino ewes mated respectively with Dorset Horn, Shropshire and Southdown rams, only two lambs by Dorset Horn rams were of marketable size, whereas 70 lambs from Longwool-Merino ewes were ready and despatched. The

numbers of these and the percentage of the total lambs of each breed are as follow:—

"TIPPERARY" LAMBS, 1931.

Ewe.	Ram.	Number ready for market.	Percentage.
Longwool-Merino ...	Dorset Horn	37	72·5
Do.	Southdown	21	38·8
Do.	Shropshire	18	35·2
Merino	Dorset Horn	2	10·0
Do.	Southdown	*Nil*	...
	Shropshire		
	Total	78	44·3

The relative development of the progeny of the Merino and Longwool cross-bred lamb by the same ram may be readily seen from the illustrations herewith.

It has been the practice to consider that Shropshire crosses would mature more quickly than the Southdown crosses. This view, however, is not supported by the Roseworthy experiments nor by the results this season from the experimental flocks at "Tipperary."

LOSS FROM FARM TO ABATTOIRS.

These losses are shown in Table 11 hereunder:—

TABLE 11.

MARKETING WEIGHT OF LAMBS SIRED BY DOWNS RAMS FROM LONGWOOL MERINO EWES.

Ram.	Ewe.	Farm weight.	Sale-yard weight.	Loss per cent.	Pre-slaughter weight.	Dressed weight.	Shrinkage in dressing.	Loss, farm to hooks.
		lb.	lb.	%	lb.	lb.	%	%
Dorset Horn	Lincoln-Merino ...	85·42	80·31	5·98	78·67	39·08	50·32	54·25
	English Leicester-Merino... ...	81·86	76·95	6·00	75·01	38·12	49·18	53·43
	Border Leicester-Merino... ...	85·46	80·14	6·23	78·52	39·59	49·58	53·67
	Romney Marsh-Merino... ...	84·79	79·81	5·87	77·93	39·29	49·58	53·66
	Merino	81·49	76·90	5·63	74·95	37·28	50·13	54·13
Shropshire ...	Lincoln-Merino ...	83·24	77·10	7·38	75·18	36·80	51·05	55·79
	English Leicester-Merino... ...	81·70	75·94	7·05	74·31	36·57	50·79	55·24
	Border Leicester-Merino... ...	83·77	78·55	6·23	76·24	38·10	50·03	54·52
	Romney Marsh-Merino... ...	83·68	78·16	6·60	76·23	35·40	53·56	57·70
	Merino	80·83	75·22	6·94	73·15	35·20	51·88	56·45
Southdown...	Lincoln-Merino ...	80·16	75·26	6·11	73·72	36·98	49·84	53·87
	English Leicester-Merino... ...	80·11	75·13	6·22	73·63	37·62	48·91	53·04
	Border Leicester-Merino... ...	82·73	78·18	5·50	76·28	39·27	48·52	57·70
	Romney Marsh-Merino... ...	81·52	76·73	5·88	75·17	37·88	49·61	53·53
	Merino	78·76	74·14	5·87	72·52	37·27	48·61	52·68

It will be seen that the lambs from the crossbred mothers travel and "kill" just as well, and in most cases, slightly better than those from Merino mothers by the same sires. It will also be seen that there is less shrinkage with the progeny of the Southdown than with the progeny of any of the other Downs breeds, and from this, and the previous information relative to maturity, it is possible to calculate the approximate relative times necessary for the production of export lambs of a given carcase weight, say, 32 lbs., by Downs sires and from Merino and Border Leicester ewes. The result of these calculations is set out in Table 12 hereunder:—

TABLE 12.

COMPARISON OF WEIGHTS AND AGES IN REACHING MARKET CONDITION.

Lamb.	Dressed weight on hooks.	Live weight on farm.	Weight at birth.	Average weekly gain.	Age in weeks.
	lb.	lb.	lb.	lb.	
Merino	32	78	8·0	3·3	21
Southdown-Merino	32	68	8·5	3·8	15½
Shropshire-Merino	32	73	8·5	3·8	17
Dorset Horn-Merino	32	70	9·0	4·2	14½
Southdown-Border Leicester Merino	32	67	10·0	4·2	13½
Shropshire-Border Leicester Merino	32	70	10·0	4·3	14
Dorset Horn-Border Leicester Merino	32	69	10·5	4·9	12

The results of the grading of the Southdown lambs marketed on 16th September, 1931, from the "Tipperary" and Avondale Experiment Farm experimental flocks are hereunder and show the superiority of the Longwool-Merino crossbred ewe to the Merino as the mother of the export lamb.

QUALITY OF CARCASES.

Ram.	Ewe.	No. of Lambs.	Percentage of Carcases.			
			1st Grade.	2nd Grade.	3rd Grade.	Reject.
			%	%	%	%
"Tipperary"—						
Southdown ...	Longwool Merino ...	33	78·8	21·2	...	...
Do. ...	Merino	18	66·7	16·7	11·1	5·5
Avondale Farm—						
Southdown ...	Border Leicester-Merino	4	100	...	...	...
Do. ...	Merino	4	75·0	25·0	...	...

In both cases the highest percentage of first-quality lambs was obtained from the Longwool crossbred ewe. It was also noticed, from an examination of the lambs prior to slaughter, that the progeny of the crossbred ewes were broader in the back, thicker in the flanks and shoulders and in every way were more in accordance with the requirements of the export market.

The result of grading the dressed carcases for quality is shown in Table 13 hereunder:—

TABLE 13.

QUALITY OF CARCASES.

Ram.	Ewe.	First Grade.	Second Grade.	Third Grade.	Reject.
		%	%	%	%
Dorset Horn ...	Lincoln-Merino	66·10	30·51	3·39	0·00
	English Leicester-Merino ...	76·36	23·64	0·00	0·00
	Border Leicester-Merino ...	58·21	31·34	8·96	1·49
	Romney Marsh-Merino ...	76·79	19·64	3·57	0·00
	Merino	63·46	36·54	0·00	0·00
Shropshire ...	Lincoln-Merino	54·39	42·11	3·50	0·00
	English Leicester-Merino ...	81·40	16·28	2·32	0·00
	Border Leicester-Merino ...	59·02	37·70	3·28	0·00
	Romney Marsh-Merino ...	57·14	33·33	9·53	0·00
	Merino	43·75	47·92	8·33	0·00
Southdown ...	Lincoln-Merino	88·52	8·20	3·28	0·00
	English Leicester-Merino ...	90·00	8·33	1·67	0·00
	Border Leicester-Merino ...	84·85	13·64	1·51	0·00
	Romney Marsh-Merino ...	84·13	14·29	1·58	0·00
	Merino	91·84	8·16	0·00	0·00

It will be seen from the above that, except in the case of the Southdown, there is a very distinct improvement in quality as the result of the use of the Longwool-Merino crossbred ewe instead of the Merino, and this applies to all breeds of the Longwool group. In both cases the Southdown ram produced the greatest number of first-grade carcases.

Having regard to the results with both types of ewe the investigators* write: "The Southdown ram is by far the best sire to use for export lamb breeding, if the object in view is the production of nicely-turned, even-fleshed and uniform carcases."

The recent (24/8/31) consignment of experimental lambs from Mr. W. G. Burges. "Tipperary," is in agreement with this. The mothers of these lambs were Longwool-Merino crossbreds, principally Lincoln-Merino. The carcases by the different rams were graded as follows:—

QUALITY OF "TIPPERARY" LAMBS, 1931.

Quality.	Mark.	Weight.	Sires.		
			Southdown.	Shropshire.	Dorset Horn.
First	Swan	Under 36	17	...	...
Do.	do.	,, 42	4	...	...
Do.	Cygnet	,, 36	...	11	17
Do.	do.	,, 42	...	5	9
Second	Curlew	,, 36	...	2	7
Do.	do.	,, 42	...	...	3
Third	... ...	...	...	...	1
	Total	...	21	18	37

* Messrs. Colebatch and Scott.

Though the best quality of the other crosses was classed as first-grade, it was very evident that the Southdown lambs were superior because of their greater plumpness, better "primeness" or "finish" and uniformity.

The monetary returns from the different crosses at the Roseworthy Agricultural College, calculated on the basis of a flock of 100 breeding ewes, are given in Table 14 hereunder. For comparison those of lambs by the same sires but from Merino ewes are included—

TABLE 14.

ANNUAL GROSS RETURNS FROM 100 EWES (EXPORT).

Ram.	Ewe.	Lambs Marketed.	Value, Lamb Carcase.	Value, Lamb Pelts.	Total Value Lambs.	Value, Ewe Fleece.	Total Return.
		%	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
Dorset Horn ...	Lincoln-Merino ...	96·72	139 0 8	27 0 0	166 0 8	73 6 8	239 7 4
	English Leicester-Merino	88·71	127 17 10	24 0 6	151 18 4	71 13 4	223 11 8
	Border Leicester-Merino	108·06	155 15 9	29 14 4	185 10 1	70 8 4	255 18 5
	Romney Marsh-Merino	90·32	132 9 5	27 9 5	159 18 10	71 5 0	231 3 10
	Merino	76·13	108 3 4	22 11 5	130 14 9	85 0 0	215 14 9
Shropshire ...	Lincoln-Merino ...	93·44	128 9 7	25 13 11	154 3 6	73 6 8	227 10 2
	English Leicester-Merino	75·49	106 18 11	20 15 2	127 14 1	71 13 4	199 7 5
	Border Leicester-Merino	100·00	142 1 8	28 6 8	170 8 4	70 8 4	240 16 8
	Romney Marsh-Merino	73·85	103 13 11	22 3 1	125 17 0	71 5 0	197 2 0
	Merino	78·69	107 4 4	23 5 7	130 9 11	85 0 0	215 9 11
Southdown ...	Lincoln-Merino ...	95·16	134 16 2	25 15 5	160 11 7	73 6 8	233 18 3
	English Leicester-Merino	98·36	142 12 5	27 1 0	169 13 5	71 13 4	241 6 9
	Border Leicester-Merino	108·20	159 2 11	29 15 1	188 18 0	70 8 4	259 6 1
	Romney Marsh-Merino	103·28	149 6 6	29 5 3	178 11 9	71 5 0	249 16 9
	Merino	81 97	118 3 6	23 4 6	141 8 0	85 0 0	226 8 0

The highest monetary returns were obtained by lambs sired by the Southdown ram from Border Leicester ewes, closely followed by Dorset Horn lambs from similar ewes. When the returns from lambs and pelts are compared, it is seen how much better (except in two cases (Shropshire-English Leicester-Merino and Shropshire-Romney Marsh-Merino) are the returns from the Longwool crossbred ewes than from the Merino ewes. To have been otherwise would have been surprising, for, as the experimental results have been examined phase by phase, it has been seen how much better mothers of the lusty, vigorous export lamb are the crossbred ewes than the Merino ewes. It has been shown that—

They are more prolific;
Are freer from lambing troubles;
Produce lambs 1½ lbs. heavier at birth;
Produce quicker maturing lambs; and
Produce more highest-grade lambs.

The relative advantage, due to the greater monetary returns from the lambs with crossbred mothers, is lowered if the value of the wool produced by the mothers is taken into account. In this connection, however, it has already been pointed out that the difference between the relative wool returns from Merino and crossbred may require to be reduced because of altered rates and different conditions obtaining on the average farm.

LAMBS FROM MERINO AND LONGWOOL CROSSBRED EWES BY THE SAME SIRE, "TIPPERARY," 24th AUGUST, 1931.

Sire—Shropshire.
Weights 6th August, 1931: Merino Ewe, 28 lbs.; Crossbred Ewe, 77 lbs.

The experiments have shown that all the Longwool-Merino crossbreds were decidedly better than pure Merinos as mothers of the Export Lamb.

The breeding of the crossbred ewes depends upon the conditions under which they are to be kept. Under Roseworthy conditions the Border Leicester-Merino cross was the most suitable, and, as these conditions are similar to those in the greater portion of our Wheat Belt, that cross will be the most suitable for that area. In the wetter districts the Romney Marsh will undoubtedly have its place because of its immunity to foot-rot. Similarly, where pastures are more plentiful and luscious, the English Leicester and Lincoln will find their placees.

Summed up, these experiments teach us definitely that, for the production of Export Lambs—

(1) **The Longwool Merino crossbred ewe is a better and more suitable mother than the Merino ewe;**

(2) **Under the conditions which obtain in the Wheat Belt the most suitable breed to mate with the Merino to produce this Longwool Merino crossbred mother is the Border Leicester, followed by the English Leicester, Lincoln and Romney Marsh, the last-named for wet districts;**

(3) **To produce the highest quality Export Lamb the Border Leicester-Merino ewe should be mated with the Southdown ram;**

(4) **When Longwool Merino crossbred ewes are not available, the best results are obtained by mating the Merino ewe with the Border Leicester ram.**

TRANSPORT, GRADING, AND MARKETING OF LAMBS FOR EXPORT.

E. H. GOLDING, Controller of Abattoirs.

Transport.

Having produced the correct type, properly fattened and finished ready for export, too much care cannot be exercised in transporting the lamb from the farm to the freezing works.

As this lamb has furnished up to the export grade, about 70 lbs. live weight or 34-36 lbs. dressed weight, in 12-14 weeks from birth and is full of sap owing to suckling the mother for the whole period, it is easy to imagine that, being so tender, it is very susceptible to being bruised.

Quick transport is essential. If the lamb is subjected to rough handling and too long a time is taken between the farm and the works, in addition to the wastage in weight, which is an economic loss, the sap will dry out and the consequent loss in this direction will not only affect the bloom but the flesh will have a tendency to become coarse. This particular item must not be lost sight of, as the fineness of the grain in the meat is largely responsible for the price realised.

Dogs should never be used in yarding or trucking if it can be avoided. Dogs that are used to working in the paddock may never bite a sheep or lamb, but dogs that are used in the yards and races loading and unloading, owing to the congestion, have a tendency to nip the lambs in the legs and flanks, and every time this is done it can be seen in the dressed carcase and is responsible for quite a number of rejects (solely from this cause). For the same reason sticks should not be used. A piece of empty chaff bag is much better.

Lambs should never be caught by the wool. This will also be reflected in the dressed carcase by a bruise wherever it happens. Whenever it is necessary to catch and handle a lamb in the yards, races or trucks, it is better to place the arm under the neck and body and lift it bodily from the ground or floor than attempt to drag it by the leg or wool.

It must never be forgotten that, after having bred the right lamb, in order to realise the maximum return, right from birth to the slaughtering floor, every factor must be strictly observed, and quite a lot of the work in preparing the lambs for export may go for nothing unless every care is observed between the time the lamb is taken from its mother and reaches the freezers.

Grading.

The first thing the grower should aim at after having secured the correct ewes and rams is a high uniform standard of quality, so that when the lambs reach the export works there will be as few as possible classed as rejects.

The ideal lamb carcase, properly finished, should be compact, symmetrical, full in the neck, broad in the back and loins, thick shoulders, buttocks and flanks, and meat down to the knees and hocks, covered with a smooth white selvedge of fat sufficient to hide the flesh. This is what is known as the bloom, and is very largely responsible for the general appearance and market value. It sometimes happens that, when a lamb is dressed, the kidney fat and general appearance are a dull yellow. This may be due to some impurities in the feed or other causes, but this carcase is invariably rejected as unfit for export.

A fault that is frequently noticed is the manner in which the lambs' tails are docked. In fact, in the majority of cases more care should be observed. The tail

is cut off between the joints, and the bone is left protruding. This causes the meat to be discoloured all round the end of the tail, and is most unsatisfactory.

The correct way to dock a lamb's tail is, before severing the tail, to draw the skin slightly towards the butt or body, then cut the tail off at the second joint. If the skin has been drawn slightly back before cutting, as soon as the tail has been severed, the skin and flesh will come back and completely cover the bone and heal over it. This leaves a more attractive and finished appearance.

A lamb at 13-14 weeks old, properly nourished and cared for, should weigh approximately 68-70 lbs. live weight on the farm, and, assuming the time taken in transit is not unreasonably long, should show a dressed weight at the freezing works of 35-36 lbs. One consignment of "Koobabbie" Southdown lambs out of Border Leicester-Merino ewes in August of this year was sent to the Metropolitan Market and purchased for export. These lambs travelled 13 miles to the railway station, taking 1½ days, were railed 175 miles, and, after being 72 hours from the farm to the export works, dressed at an average of 34½ lbs. The lambs were 12-13 weeks old, and topped the market against lambs several pounds heavier. This speaks particularly well for the Southdown lambs out of the Border Leicester Merino ewes.

The lambs are graded at the works for both quality and weight. There are four quality grades, viz., 1st, 2nd, 3rd, and rejects. These are determined by the condition and bloom of the carcases. The weight and grades are as follow:—

28-36 lbs., known in the trade as 2s.
37-42 lbs., known in the trade as 8s.
43 lbs. and over, known in the trade as 4s.

36 lbs. and under of the same quality will invariably return a higher price per pound than heavier weights on the London market, consequently as the 70 lbs. live weight will dress at 35-36 lbs., this is a safe course to adopt in order to secure a uniform consignment.

Another reason is that at this age and weight the ewe is able to thoroughly nourish the lamb, and this is reflected in the bloom when viewing the dressed carcase.

The grower should carefully hand-pick the lambs before leaving the farm for both weight and quality, in order that as few rejects as possible reach the works. It does not pay to ship third grade lambs; they will return a better price on the local market, in addition to discounting the value of the first grade lambs in the consignment.

A consignment of uniform weight and quality is calculated to return a better price than would be the case if the consignment consisted of miscellaneous sizes, even if they are of first quality.

Naturally, it is not always possible to secure a parcel of the ideal lambs, but this suggestion is made in order that growers should aim at a uniform standard of the type that will hold its own with anything we have to compete with in the Overseas market, and nothing else will put Western Australia on the map as a State that can produce lambs equal to the best, and consequently enable the grower to secure the maximum return for his efforts.

Marketing.

The latest advices from London this season are that small lambs are in most demand, and the Southdown cross is still gaining in popularity.

At present, owing to the small number available for export, the only manner in which the lambs can be marketed is either by sending to the metropolitan markets for sale by auction or consigning to the West Australian Meat Export Works at Robb's Jetty and slaughtered, frozen, shipped to London and sold on the grower's account. It is probably fairly safe to say the latter course is the better, on the assumption that the grower can supply a consignment, large or small, of the correct type and quality. By shipping the surplus lambs it will have a tendency to stabilise the local market and this, naturally, will be in the interests of the whole industry.

As time goes on and the numbers increase, no doubt export buyers will operate all over the State during the season and purchase direct from the farm. While the numbers are so limited there is not sufficient inducement for buyers to operate anywhere but the metropolitan markets.

As an illustration of the improvement in the type and quality of our lambs required, last year two or three of the early shipments that reached London in October and early November realised fairly satisfactory prices, but subsequent shipments did not realise within 2½d. or 3d. per lb. of the prices quoted for New Zealand lambs. The logical conclusion to draw is that the earlier shipments reached the market during that period between the tail end of the New Zealand season and the earlier shipments of the following season. Immediately Western Australian lambs had to compete with other new season's lambs, the prices realised were so low as to be unprofitable.

With such an area of country suitable for production of lambs and such a range in the seasons, say, from July on the Midland line to November in the lower part of the Great Southern and South-Western districts, it is not possible to market all the lambs in London in October and November. Consequently, it is absolutely essential that, in order to secure the most use from the natural pastures and produce lambs under the most economical conditions, growers must concentrate on the production of uniform lambs of the hightest quality so that they can compete at any time with the best from other countries. This will necessitate breeding along standardised lines and achieving a reputation for quality and uniformity which New Zealand has obtained for "Canterbury" lambs.

HORTICULTURAL NOTES.

GEO. W WICKENS, Superintendent of Horticulture.

Up to the time of writing (12th August) weather conditions have been most favourable for the development of fruit buds on deciduous trees. Good rains since the middle of May have supplied the soil with a generous quantity of moisture without making it boggy, and heavy frosts during June rendered the trees thoroughly dormant comparatively early in the season. In the latter connection this season differs in a marked manner from last, when the winter weather was so mild that many apple trees did not cease growing until the end of June, and there is no doubt delayed dormancy had the effect of causing the trees to bud later than usual in the Spring

In districts where thrips are liable to appear a delay in blooming, even of only one week's duration, may mean the difference between a good crop and a failure, and those who suffered from the thrips invasion of last October will no doubt have cheerfully borne the icy cold morning's of this year's June, knowing that on the one

hand they would be likely to cause the trees to bloom at normal time, and on the other would tend to delay the appearance of the pest. The apple trees in the Southern districts—Cranbrook, Mount Barker, Albany, Kalgan—where thrips caused a failure of the crop last season, are now abundantly covered with fruit-buds and I would like to again impress on growers there the necessity for thinning the fruit in November and December if a heavy setting takes place. In every year of big crops we see thousands of cases of small fruit, nearly unsaleable, or saleable only at prices which do not pay for marketing, and yet the lesson that "it pays to thin" seems as far off as ever from being learned. I think one reason for this is caused by the alternating crops; if it were possible for two heavy crops to occur in successive years there would be no time for forgetfulness, and thinning would engage the orchardist's attention just as regularly as pruning, cultivation and other essentials in horticultural husbandry do now; but when the heavy year follows the lean year only the latter is remembered on the occasion of the next heavy crop, and the fear that thinning will reduce the yield again becomes an obsession with many growers, and the work is not carried out. It may perhaps be worth while to state once more that judicious thinning *does not* reduce the number of cases of fruit for market, it only reduces the number of individual fruits, and it *does improve* the quality.

Particulars in connection with the export of fruit from Western Australia for year ending 30th June, 1931, showing quantities and destinations, will be of interest to growers, and are as follows:—

EXPORT OF FRESH FRUIT FROM WESTERN AUSTRALIA FOR YEAR ENDING 30TH JUNE, 1931.

Destination.	Apples.	Pears.	Quinces.	Grapes.	Peaches.	Plums.	Lemons.	Melons.	Oranges.	Total.
	cases.	cases.	cases.	cases.	cases.	cases.	cases.	cases.	cases.	cases.
Colombo ...	7,988	...	...	17,133	...	...	...	...	1,361¼	26,482¼
Port Said ...	6,554	...	...	181	...	...	...	...	...	6,735
Batavia ...	6,177	362¾	...	2,198	23	51½	50	...	918	9,780¼
Sourabaya ...	7,145	212½	...	2,785	5	58	25	4	413	10,647½
Singapore ...	11,793	576¾	...	7,081	101½	144	190	...	1,923	21,809¾
London ...	150,204	12,486¼	27	17,291	½	8	...	½	...	180,017¼
Bombay ...	106	...	...	350	...	...	...	...	...	456
Glasgow ...	25,218	...	...	...	...	...	...	...	...	25,218
Liverpool ...	13,673	...	...	502	...	...	...	...	...	14,175
Hull	1,170	...	...	100	...	...	...	...	...	1,270
Southampton ...	1,933	...	...	204	...	...	...	...	...	2,137
Hamburg ...	147,299	2,785½	6	...	...	...	...	...	...	150,090½
Stockholm ...	68,687	350	...	500	...	...	...	...	...	69,537
Copenhagen ...	15,392	...	...	50	...	...	...	...	...	15,442
Bremen ...	10,098	...	...	...	...	...	...	...	50	10,148
Dunkirk ...	5,158	...	...	...	...	...	...	...	...	5,158
Durban ...	3,422	...	...	...	...	...	...	...	...	3,422
Mauritius ...	50	...	...	50	...	...	...	...	...	100
Rangoon ...	260	...	...	50	...	...	...	...	25	335
Samarang ...	75	...	...	...	...	...	...	...	...	75
Palembang ...	20	...	...	...	...	...	...	...	...	20
Penang ...	6	...	...	5	...	...	...	...	100	111
Wellington, N.Z.	...	...	...	...	...	...	...	...	175	175
Auckland, N.Z.	...	...	...	...	...	...	10	...	225	235
Shanghai ...	...	...	...	...	...	...	...	...	100	100
Hong Kong ...	210	...	...	...	...	...	...	...	100	310
Lyttleton, N.Z.	...	...	...	...	...	...	...	...	70	70
Dunedin, N.Z.	...	...	...	...	...	...	...	...	70	70
Totals ...	482,638	16,773¾	33	48,480	130	261½	275	4½	5,530½	554,126

It will be noted that apples, grapes and pears, in the order mentioned, are our principal export fruits and the quantity of grapes sent away this year had only once been exceeded. This occurred in 1929, when 48,683 cases were exported, but prices received this year were considerably better than in 1929. Oranges, unfortunately, still rank low in quantity exported—under 6,000 cases out of an annual average production of over 200,000 cases and it is hoped experiments now being conducted by the Council for Scientific and Industrial Research in treatment before shipment

will prove successful and enable citrus fruits to be landed on the overseas markets in good condition, for the difficulty connected with this has in the past been the principal reason why oranges have not been exported in larger quantities from Western Australia.

A review of particulars of acreage and production for year ending 30th June, 1930 (latest figures available), show that the area under orchards increased by 136 acres, from 18,735 to 18,871, and that the increase was almost wholly due to apple trees, the area under these having risen from 10,468 acres in 1929 to 10,885 in 1930—an increase of 417 acres. The principal decreases in the period mentioned occurred in orange trees—75 acres, and pear trees—72 acres.

The area under vineyards shows a small increase of 21 acres.

Particulars of acreage and production of all kinds of fruit for season 1929–30, are as follow :—

FRUIT PRODUCTION AND ACREAGE FOR SEASON 1929–30.

Kinds of Fruit.	Area.			Yield.
	Unproductive acres.	Productive acres.	Total acres.	bushels.
Oranges	440	2,416	2,856	218,386
Mandarins	19	161	180	14,102
Lemons	46	457	503	58,180
Other Citrus Fruits ...	8	20	28	3,894
Apples	3,028	7,857	10,885	442,243
Pears	122	893	1,015	87,461
Peaches	174	633	807	65,547
Apricots	135	553	688	62,193
Nectarines	56	151	207	15,231
Plums	240	675	915	70,732
Quinces	15	80	95	8,287
Figs	49	301	350	34,950
Bananas and Plantains ...	1	7	8	1,684
All other Fruit Trees ...	78	200	278	Value £6,656
Strawberries	...	25	25	42,449 quarts
Other Small Fruits	...	31	31	Value £492
Totals	4,411	14,460	18,871	...
Grape Vines.				cwts.
Table Grapes	...	1,030	1,030	57,995
Wine Grapes	...	1,338	1,338	46,058
Drying Grapes	...	2,233	2,233	172,676
Grape Vines not bearing ...	363	...	363	...
Totals	363	4,601	4,964	276,729

It will be noted from the above, that of a total area under orchards of 18,871 acres, 10,885 acres or 57·6 per cent. is comprised of apple trees.

PLANT PROTECTION AND APICULTURE.

H. Willoughby Lance,
Apiculturist.

The "Bee World" for May, 1931, gives a summary of a broadcast lecture by Professor Dr. Borchert on the above subject, and as plant protection and apiculture are both related to the agricultural wealth of Western Australia as much as to that of any other country, I propose to deal briefly with the subject in these pages.

It is not so long ago that beekeeping was considered by many as the hobby of a few cranks, but if we go further back, we find that it was an important pursuit and means of wealth long before Great Britain became a part of the civilised world. At the present time apiculture is a most important industry in many countries, not only for the production of honey, but also on account of its importance for the efficient fertilisation of fruit-trees and flowers.

Plant protection is not of such ancient date as beekeeping, but is a most important part of present-day agriculture; and its aim, like that of apiculture, is to increase the agricultural wealth of the country. Diseases and pests attacking cultivated trees and plants, and the excessive growth of weeds, are responsible for many crop failures. Plant protection by the use of washes, sprays, dusts, and traps aims at controlling or destroying these pests and thus increasing the yield.

Apiculture has to struggle against the competition of sugar, diseases which attack bees, and the destruction of nectar-bearing trees. To these has been added another danger that of plant protection. If diseased plants are treated at the wrong time, or in an unsuitable manner, bees as well as pests may be destroyed.

It is to be feared that many orchardists and market gardeners do not realise the importance of the little insect, of which so many persons are afraid, for the success of their industry, and that the bee is really their friend. It is a certain fact that if all bees were destroyed many crops would fall to an unprofitable figure.

The importance of the bee as a pollinating agent is in some countries realised to such an extent that orchardists will pay beekeepers 12s. to 15s. per colony to place their hives in their orchards at blossoming time. This may seem an excessive amount, but if the colonies are strong and in condition for the work, and the orchard conditions are correct, the increased crop much more than compensates for the outlay. In market gardening much the same applies, particularly in the case of pumpkins. Many instances are known where there has been a good flowering of pumpkins, but very little setting of fruit; but in the following year, bees having been introduced, there has been a heavy crop. Bearing these facts in mind, it behoves all those interested in plant protection to insure that when they are destroying pests, they are not also destroying their friends.

The chief danger lies in the fact that the means most convenient for the combating of pests and diseases contain chemical substances such as sulphur, copper, arsenic, fluorine, etc. If these are used in the winter to destroy eggs of pests, or diseases, very little harm results to the bees, as the blossom is not there to attract them; also, many of the sprays and washes used at this season do not contain substances harmful to bees. The most harm is done in the spring and the summer, when the bees are most active and blossom is most plentiful. The danger, however, is not so great if sweet substances, attractive to bees, are not added to the sprays. The greatest care is required in the spring time, when orchards are

in blossom. It is essential that sulphur, copper, or arsenical mixtures are not applied at the time of blossom, as this is certain to result in the destruction of many thousands of bees. The same applies to vegetable gardens.

In America and Germany aeroplanes have been used to distribute poisonous dusts over the forests, to destroy forest pests. Serious damage has resulted to many beekeepers as a result, and in one case in Germany a beekeeper, who lost 353 colonies as a result of this dusting, was fortunate in securing compensation of £370.

Seeing that many apiculturists depend upon beekeeping for a living, and that beekeeping is a most important branch of agriculture owing to the great services rendered by bees, it is only right and in the interests of the persons concerned that measures of plant protection should be carried out in such a way as not to be harmful to bees. Bees are very sensitive to poisons and it is stated that 2/1,000,000ths of a gramme of metallic arsenic, 9/1,000,000ths of copper or 13/1,000,000ths of sodium fluorine is sufficient to kill a bee.

Abundant evidence has been produced by investigators working in all parts of the world, which shows that, other factors being equal, the honey bee is the principal factor in the efficient pollination of fruit trees and many vegetables.

Remember that *More Bees means More Fruit*—see "Pollination of Orchards," *Agricultural Journal*, June, 1930, page 316. In the opinion of many, the honey bee is more valuable to mankind on account of the work it does in the pollination of plants and trees—that produce millions of pounds' worth of food—than for the amount of honey it produces. Beekeeping has, therefore, a double value, not only being profitable to the apiarist himself, but of even greater value to his neighbour.

SEED AND SEED-BED DISINFECTION.

FUNDAMENTAL PRINCIPLES OF PLANT DISEASE CONTROL.

H. A. PITTMAN, B.Sc. Agr.,
Plant Pathologist.

There are many different ways in which parasitic organisms may gain access to a property or field, etc., on which they have not previously occurred. In the case of cereal, vegetable and flower-garden plants, which are typically grown afresh each season from seed, a very common, and often unsuspected, method is by means of the seed itself; using the term in its very widest sense to include such natural vegetative means of propagation as bulbs, corms, tubers, rhizomes and similar plant structures.

The parasitic organisms so introduced may occasionally be visible to the naked eye, as in the case of wheat grains heavily infested at the "brush" end with "bunt" spores (*Tilletia spp.*), or potato tubers affected with "Rhizoctonia Scab" (*Rhizoctonia solani*); but much more frequently they are present, either inside or outside the seeds, in the form of bacterial cells or fungal spores or threads which are quite invisible to the naked eye. Many of them, indeed, may only be detected with difficulty even with microscopic or other laboratory means.

It thus comes about that a sample of seed wheat, which may appear perfectly clean and satisfactory to the unaided vision, may actually be heavily infected

internally with the "loose smut" fungus (*Ustilago tritici*), while a sample of cabbage seed quite healthy to look at may be heavily contaminated with the bacteria responsible for "black rot" (*Pseudomonas campestris*). "Fusarium Wilts" of tomatoes and watermelons, due to *Fusarium lycopersici* and *F. niveum*, respectively, provide other very good examples.

Of recent years there has been a steady increase in this State in the number of seed-borne diseases attacking vegetable- and flower-garden plants, and also in the number of plants affected.

This may be attributed very largely to the almost complete absence of seed-disinfection methods on the part of the vast majority of flower and vegetable-growers. Those few progressive persons who have regarded seed and seed-bed disinfection as routine parts of their crop-production activities, have been repaid for the extra time and trouble many times over. On the other hand, cases have come under the notice of the writer where growers have been practically forced out of business, at least with particular crops, because they have neglected to do so. This has been particularly obvious in the case of "black leg" of cabbages and cauliflowers (*Phoma lingam*), "Fusarium Wilts" of tomatoes, watermelons and "Queensland Blue" pumpkins, and "Black Rot" of cabbages and cauliflowers.

The most fundamental principle of plant disease control, in the case of crops propagated from seed, may be summed up in the phrase, "Plant clean seed or seedlings in clean soil"—using the term "clean" as synonymous with "disease-free." This must be followed up, of course, wherever necessary and economically possible, in the case of wind- or insect-disseminated diseases, by spraying with appropriate fungicides or insecticides to keep the so-far clean plants from becoming diseased from external sources of infection.

The above programme involves, logically, the following steps:—

(1) Seed disinfection, or the use of known disease-free seed.
(2) Seed-bed disinfection, or the use of known disease-free soil.
(3) Planting-out, in the case of transplanted crops, into disease-free soil, or alternatively into soil which has not grown the same or closely related susceptible plants for several years—the rotation or rest-period in the interim being always as long as is economically possible.
(4) Spraying the above-ground parts of the plants, if necessary, to prevent infection from outside sources.
(5) Eradication, where possible, of any internal or external sources of infection not already covered by (1) and (2).

To these may be added:—

(6) Manipulation, if possible, of the environmental factors, such as atmospheric humidity (where overhead sprinklers are used, in glasshouses, etc.), soil reaction (acidity or alkalinity, pH), soil moisture relations, or time of the year when the plants are grown, so that even if the disease is present it will do only a minimum of damage.

Better than all these things, of course, where practicable, is the growing of resistant varieties, but unfortunately in very many cases this method is still rather an ideal than a reality.

Table 1 gives a list of the disinfection methods most commonly recommended for cereal, vegetable, and flower-garden seeds. In every case strict attention must be given to detail, so that the disease-producing organisms may be killed, without, at the same time, causing any serious injury to the seed.

TABLE I.

SUMMARY OF SEED TREATMENTS FOR PREVENTING OR REDUCING SEED-BORNE DISEASES OF VARIOUS CROPS.

A.—CEREAL CROPS.

Crop.	Disease.	Pathogen.	Disinfectant.	Quantity, Strength or Temperature.	Method of Treatment and Remarks—Further References, Cautions, etc.
Wheat	Bunt or Stinking Smut	*Tilletia laevis* or *T. tritici*	Copper Carbonate ..	2-3 ozs. per bushel (dust treatment)	Mix in tightly-closed container until each grain is thoroughly coated with the dust. Do not inhale the dust. Seed may be treated any length of time prior to sowing. (*See* Leaflet 160).
Do.	Flag Smut	*Urocystis tritici* ..	do.	2-3 ozs. per bushel (dust treatment)	As above. Only useful to prevent infection of clean paddocks by seed carrying "flag smut" spores. Use also the following control measures: Harvest infected crops for grain, not for hay; burn stubble; fallow early and cleanly, rotate with oats, barley, peas, etc.; then fallow again; then sow wheat shallowly in moist seed bed. Best of all grow resistant varieties on infected paddocks. (*See* Leaflets 160 and 326).
Do.	Loose Smut	*Ustilago tritici*	Hot water	129° F.	Treat seed in sacks only half filled and tied at the top. Soak 4–5 hours in cold water at ordinary temperature; then dip in water at 120° F. for about one minute; then soak 10 minutes at 129° F. Temperature must not exceed 131° F. or fall below 124° F. during treatment. Then plunge into cold water and spread out thinly to dry. Use this seed to plant an isolated seed plot and save all resultant seed to plant following year without further treatment. The best method is to obtain clean seed from Government Farm, or some other clean crop in first place. (*See* Leaflet 160)
Do.	do.	do.	do.	120° F.	Alternatively to above. Treat seed 1 hour 35 minutes at 120° F. In sacks only half filled and tied at top, then plunge in cold water and spread out to dry. *See* last three sentences of previous paragraph.
Barley	Covered Smut	*Ustilago hordei* ...	Formalin...	1 pint in 40 gallons water	Soak 30 minutes, or alternatively spread grain out on clean floor or tarpaulin and sprinkle with the formalin at strength indicated, turning heap repeatedly with shovel until every grain moistened. This takes about ¾ gallon to every bushel of grain. Then cover with bags, etc., moistened with the formalin solution and leave covered for 4–6 hours. Remove covers and spread grain out thinly to dry. Sow as soon as dry enough to run through drill. Plant in moist seed bed or germination may be considerably reduced. (*See* Leaflet 160).

TABLE I.—*continued.*

A.—CEREAL CROPS—*continued.*

Crop.	Disease.	Pathogen.	Disinfectant.	Quantity, Strength or Temperature.	Method of Treatment and Remarks—Further References, Cautions, etc.
Barley—*continued.* ...	Loose Smut	*Ustilago nuda*	Hot water	126° F.	Treat seed in sacks only half filled and tied at the top. Soak 4–5 hours in cold water at ordinary temperature ; then dip in water at 120° F. for about 1 minute ; then soak 13 minutes at 126° F. Temperature must not exceed 129° F. or fall below 124° F. during the final treatment. Plunge into cold water. Spread out to dry. This treatment kills both "loose" and "covered" smuts of barley. The treatments given under "covered smut" of barley kill some of the "loose smut" at the same time as the "covered smut" but not all.
Oats	Loose and Covered Smuts	*Ustilago avenae and U. laevis*	Formalin	1 pint in 35 to 40 gallons water	Soak 30 minutes, or, alternatively, use sprinkling method as detailed under "covered smut" of barley, leaving heaps covered 6 to 8 hours. In any case spread out grain to dry at end of period and sow as soon as dry enough to run through drill, in moist seed bed. (*See* Leaflet 160).

B.—VEGETABLE GARDEN PLANTS, ETC.

Cabbage and Cauliflower	Black Rot	*Pseudomonas campestris*	Mercuric chloride (Corrosive sublimate)	1 in 1,000	Immerse seed for 30 minutes in the case of cabbage, and 20 minutes for cauliflower. After removing from the solution allow to drain for a minute or two, then rinse for 15 minutes in clean running water. Drain and spread out thinly to dry in cool shady place. *See* section in text on "Method of using the Diluted Corrosive Sublimate," for fuller details.
Do.	Black Leg	*Phoma lingam*	Hot water	122° F.	Immerse seed in loose muslin or cheese-cloth bags in water at 122° F. for 30 minutes. Keep bags and water constantly stirred with thermometer. If necessary, add small amount boiling water slowly from time to time to keep up the temperature. At end of time remove, plunge into cold water, drain and spread out thinly in cool shady place to dry. The corrosive sublimate treatment given above is fairly effective against "black leg" but does not kill any fungus threads actually within the seed coat as does the hot water treatment.

TABLE I.—*continued.*

B.—VEGETABLE GARDEN PLANTS, ETC.—*continued.*

Crop.	Disease.	Pathogen.	Disinfectant.	Quantity, Strength or Temperature.	Method of Treatment and Remarks—Further References, Cautions, etc.
Potato	Common scab, Rhizoctonia and Black Leg, etc.	*Actinomyces scabies*, *Rhizoctonia solani*, and *Bacillus atrosepticus*, etc.	Mercuric chloride (Corrosive sublimate)	1 in 1,000. 4 ozs. Sublimate to every 25 gallons water. *See* formula "f" table 11	Soak tubers, uncut and unsprouted, for 1½–2 hours. The solution weakens with use, therefore one ounce of dissolved sublimate (1 pint stock solution as per Table 11) should be added to each 25 gallons, after each lot has been treated. Also add any necessary water to bring volume up to the original level each time. An entirely fresh solution should be prepared after treating four lots. Each 25 gallons of solution treats about 5 bushels of tubers. Dip tubers in wooden crates, not bags, or else immerse directly into barrel or vat if provision has been made to drain the solution into another container after the treatment. Effectiveness of the treatment is greatly increased by dipping tubers in water and keeping moist for a day or two before treatment. If this is done soaking period may be reduced to half hour. If tubers are washed to remove dirt before dipping, and are not immersed in the bags, the solution may be used six to eight times before discarding, provided it is strengthened each time as described. (*See* Leaflet 72)
Do.	do.	do.	Cold Formalin	1 pint to 30 gallons water	Soak tubers unsprouted and uncut 1½–2 hours. If tubers are moistened before treatment as described above, soaking period may be reduced to half hour and effectiveness increased. (*See* Leaflet 72). Solution keeps its strength but more solution should be added, as required, to keep up the volume to original level.
Do.	do.	do.	Hot Formalin	1 pint to 15 gallons water at 122° F.	Soak tubers, unsprouted and uncut, 3–4 minutes, but no longer. Temperature must be kept between 121° F. and 123° F. during treatment. Then spread out thinly in cool shady place to dry.
Tomato	Fusarium wilt	*Fusarium lycopersici* ...	Mercuric chloride (Corrosive sublimate)	1 in 3,000	Use formula (a) in Table III., but make up with water to 1 gallon 1⅛ pints, or use formula (b) of same table, but make up with water to 2 gallons 2¾ pints. Treat for 5 minutes, stirring frequently. Wash 15 minutes in clean running water and spread out thinly in cool shady place to dry.
Watermelon and Pumpkin	Fusarium wilt	*Fusarium niveum* ...	Mercuric chloride ...	1 in 1,000	Treat for 5 to 7 minutes, stirring frequently. Wash in clean running water for 15 minutes, and then spread out in cool shady place to dry.

TABLE I.—*continued.*

B.—VEGETABLE GARDEN PLANTS, ETC.—*continued.*

Crop.	Disease.	Pathogen.	Disinfectant.	Quantity, Strength or Temperature.	Method of Treatment and Remarks—Further References, Cautions, etc.
Celery	Early and Late Blight	*Cercospora apii, Septoria apii*	Mercuric chloride ...	1 in 1,000	Treat for 30 minutes as cabbage seed above. Sow while still moist.
Do.	do.	do.	Hot water	118° F.	Treat for 30 minutes as cabbage seed above, but with temperature at 118° F. instead of 122° F. Sow while still moist.
Other Vegetable seeds	Various	Various	Mercuric chloride ...	1 in 1,000	Treat for 5 minutes, stirring frequently. Wash 15 minutes in clean running water, and then spread out thinly in cool shady place to dry.
Tobacco	Downy Mildew ("Blue Mould")	*Peronospora sp.* ...	Alcohol	Absolute	Immerse 5 minutes in muslin bag. Drain one minute or so, spread on clean dry blotting paper in thin layer, turn over several times, and place in cool airy place to dry. This Department will treat at charge of one shilling per ounce, or part thereof.
C.—FLOWER GARDEN PLANTS.					
General Seed Treatment for common diseases of flower-garden plants	Various	Various	Mercuric chloride (Corrosive sublimate)	1 in 1,000	Immerse seeds with thin seed coats or which absorb moisture readily for 5 minutes only with frequent stirring. Most other flower garden seeds can be immersed for 15–30 minutes without injury. Rinse in clean running water for 15 minutes after treatment, and spread out in cool shady place to dry, or sow while still moist.
Gladiolus	Bacterial Scab, Septoria Hard Rot, etc.	*Bacterium marginatum, Septoria gladioli*, etc.	Mercuric chloride ...	1 in 1,000	Soak unsprouted corms for 2 to 4 hours. Allow to drain and spread out thinly in cool shady place to dry.
Do.	do.	do.	Organic Mercury compounds such as "Semesan"	... ...	Use as recommended by the manufacturers.

ACKNOWLEDGMENT.

The writing of this article and the preparation of Table 1 has been inspired by the United States Department of Agriculture Miscellaneous Publication, No. 94, "Seed Treatment Reduces Losses from Plant Diseases," by F. C. Meier, Principal Pathologist in Charge, Office of Barberry Eradication, U.S.D.A., Bureau of Plant Industry, the assistance of which is hereby gratefully acknowledged.

PREPARATION OF CORROSIVE SUBLIMATE FOR SEED DISINFECTION.

Stock Solutions Recommended.

Corrosive sublimate (mercuric chloride) is the chemical most commonly used for the disinfection of vegetable- and flower-garden seeds, the most frequently used formula being that known as "1 in 1,000." This means 1 part by weight of Corrosive Sublimate (Mercuric Chloride) to 1,000 parts by weight of water. In publications originating in the United States of America, the directions for making up this "1 in 1,000" strength, are to dissolve the Corrosive Sublimate at the rate of 1 ounce in 7½ gallons of water. In British countries, however, the gallon measure used is larger than that used in the U.S.A., so that *the correct formula where using the Imperial gallon as a measure of volume is at the rate of corrosive sublimate 1 ounce avoirdupois in 6¼ Imperial gallons of water.*

Where large quantities of Corrosive Sublimate solution are required, as in the disinfection of potato tubers or gladiolus corms, *the most convenient method of preparation is to make up a stock solution at the rate of one pound of finely-powdered sublimate in two gallons of hot water.* The poison may be dissolved by carefully pouring the hot water over it in the bottom of a wooden, earthenware, glass or enamelled vessel. After cooling, the solution should be stored in a tightly-stoppered, clearly-labelled, glass or earthenware jar, etc., under lock and key, till required. Metal containers must never be used for Corrosive Sublimate solutions, as they are corroded by the disinfectant. The chemical only dissolves very slowly in cold water, so that hot water should be used whenever possible in making up the stock solutions.

TABLE II.

DILUTION TABLE FOR MAKING 1 IN 1,000 CORROSIVE SUBLIMATE SOLUTION, USING A STOCK SOLUTION OF ONE LB. CORROSIVE SUBLIMATE IN TWO GALLONS OF WATER (OR HALF LB. IN ONE GALLON).

Stock Solution. Take amount indicated below.	Amount of dissolved sublimate in quantity of stock solution taken.	Dilute with clean cold water in wooden, glass, cement or earthenware container to final volume indicated below.
(a) ¼ pint	½ ounce	1 gallon 4½ pints
(b) ½ ,,	½ ,,	3 gallons 1 pint
(c) ¾ ,,	¾ ,,	4 ,, 5½ pints
(d) 1 ,,	1 ,,	6 ,, 2 ,,
(e) 1 quart	2 ounces	12 ,, 4 ,,
(f) ½ gallon	4 ,,	25 ,,
(g) 1 ,,	8 ,,	50 ,,
(h) 2 gallons	1lb.	100 ,,

In cases where it is anticipated that only very little of the disinfectant will be required, a more convenient stock solution may be prepared by dissolving ½ *ounce* of Sublimate in *1 quart* of hot water (or *2 ounces in one gallon*) by the same method as indicated above. For use this second stock solution is diluted as follows:—

TABLE III.

DILUTION TABLE FOR MAKING 1 IN 1,000 CORROSIVE SUBLIMATE, USING A STOCK SOLUTION OF ONE HALF OUNCE (½oz.) IN ONE QUART OF WATER (OR TWO OUNCES IN ONE GALLON.)

Stock Solution. Take amount indicated below.	Amount of dissolved sublimate in quantity of stock solution taken.	Dilute with clean, cold water in wooden, glass, cement or earthenware container to final volume indicated below.
(a) ¼ pint	1/16th ounce	3½ pints
(b) ½ ,,	1/8th ,,	6½ ,,
(c) ¾ ,,	3/16ths ,,	1 gallon 1½ pints
(d) 1 ,,	¼ ,,	1 ,, 4½ ,,
(e) 1½ pints	3/8ths ,,	2 gallons 2¾ ,,
(f) 1 quart	½ ,,	3 ,, 1 ,,
(g) ½ gallon	1 ,,	6 ,, 2 ,,
(h) 1 ,,	2 ounces	12½ ,,

The strengths of all stock solutions should be written on the labels as soon as the solutions are prepared, and it would be just as well also to include a copy of the appropriate dilution table on the same or a separate label on the container.

Mercuric Chloride (Corrosive Sublimate) is deadly poisonous to human, animal or plant life. In addition, it is colourless, odourless, and comparatively tasteless, and may easily be mistaken in solution for pure water. It should, therefore, be used with great care and kept out of the reach of children or farm stock. When finished with, the solution should be poured into a hole in the ground, and the hole be immediately filled in or covered over. In case of mercuric chloride poisoning give whites and yolks of eggs mixed with milk. In emergency, ordinary flour paste may be used. Then give a mustard emetic to induce vomiting and send immediately for medical assistance.

METHOD OF USING THE DILUTED CORROSIVE SUBLIMATE FOR DISINFECTING SEEDS.

The seeds are best immersed in the dilute Corrosive Sublimate in a cheese-cloth or muslin bag of such a fineness of weave that the seeds being disinfected will not fall through the meshes of the material. The bag should be kept constantly agitated in the solution so as to remove air bubbles, which otherwise tend to prevent intimate contact between the solution and portions of the seed coats. The capacity of the bag should be so great in proportion to the volume of the seeds being treated that they will be very free to move about inside the bag during the treatment. At the end of the time specified in Table 1 for the particular kind of seed being treated, remove the bag, with its contained seeds, from the solution, allow to drain for a minute or two, and then immerse in clean running water for 15 minutes, before tipping out the seeds in a clean shady place to dry before re-packeting or sowing. If repacketing the seeds, use a brand new packet, the old one having in the meantime been destroyed by fire, or in some similar manner, and the hands having been thoroughly washed with soap and water before handling the seeds again.

SEED-BED DISINFECTION.

It is of little use going to all the trouble, time and expense of seed disinfection if the disinfected seeds are then to be planted into infected soil.

Where seeds are planted in seed-beds from which the seedlings are subsequently transplanted into the field or garden, as in the case of many vegetable and flower-garden plants, the simplest and cheapest means, in many cases, of avoiding infection from the soil, is to prepare a new seed-bed each time from soil which has not previously grown any of the same or closely-related kinds of plants.

If this method is impracticable on account of the limited area of suitable soil on the property, or for any other reason, it may be necessary to use an old seed-bed many times over. In such instances some form of seed-bed disinfection should always be practised. The most commonly used seed-bed disinfectants are steam, fire, or formalin.

STEAM STERILISATION.

When properly used, steam is the most effective sterilising agent for soil yet known. Some of the more common methods by which it is applied in other countries are by the use of underground drain tiles, covered perforated steam pipes, the "inverted pan" and "steam rake." Where steam heating outfits for glasshouse crops are very common, as in England and many parts of the United States, it is natural that steam sterilisation of the soil should be much practised. Owing to the almost complete absence of such equipment from the market- and flower-gar-

dens of this State, however, steam sterilisation is for the most part quite impracticable. The only method which could be at all conveniently used, and then only in rare instances, is that known as the "inverted pan" system.

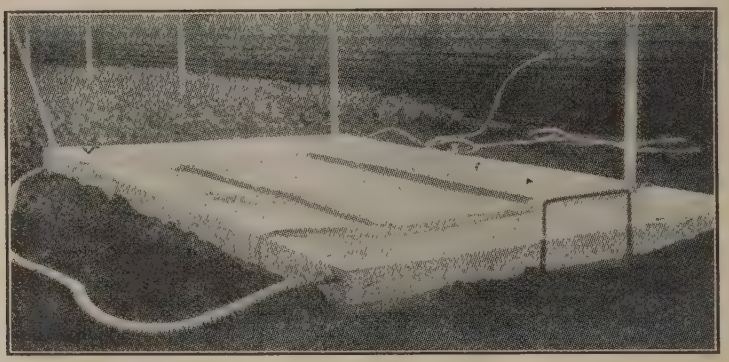


Fig. 1.—Showing a method of sterilising soil by steam, using the "inverted pan" system. Note the flexible steampipe entering the heavy-gauge galvanised iron pan at the front left corner. Note also the handle at the front for lifting the pan from one site to another. The rear handle is hardly obvious in the photograph.—*After Chupp, "Manual of Vegetable Garden Diseases."*

This involves the use of a steam boiler, from which steam under a pressure of about one hundred pounds to the square inch is forced through flexible, heavy rubber hose, into an oblong shallow pan of heavy-gauge galvanised iron, or boards, which has been turned upside down over the seed-bed to be sterilised. The usual time for sterilising under the pan is from one-half to one and one-half hours at a pressure of 80 to 100 lbs. (see Fig. 1). Further details may be obtained, if required, on application to the Department of Agriculture.

STERILISATION BY FIRE.

A method which is much in use in Australia, as well as other countries, especially for tobacco seed-beds, is by the use of a sustained wood fire on the site of the bed for at least four hours. This method is very cheap in many country districts where wood can be obtained for the mere labour of collecting it, and it deserves to be used much more extensively in market- and flower-garden practice than it is at present. In addition to its beneficial action in destroying harmful organisms, the resultant wood ashes from the fire add a valuable fertilising ingredient to the soil. The heat should be sufficient to cook a 4oz. potato buried in the soil three inches deep, or an egg buried five inches deep.*

STERILISATION WITH FORMALIN.

Formalin may be used very effectively for sterilising seed-beds, its only disadvantages being that it is rather expensive and that the treatment must be commenced about a fortnight or so before the seeds are to be sown.

The formula now being mostly recommended is 1 gallon of commercial (40 per cent.) formalin to 49 gallons of water (*i.e.*, a 2 per cent. solution). The solution so prepared is applied with a watering-can to the soil, which should previously have been well loosened up, at the rate of about one-half to one and one-half gallons

*N. A. R. Pollock, "Tobacco Seed Beds," Queensland "Agricultural Journal," Vol. 34, Part 4, pp. 408-412, October, 1930.

of the solution to the square foot. The heavier the soil, the more needs to be used. The treated soil is then smoothed down and covered with bags moistened with the formalin solution, and left for several days. Forty-eight hours is usually enough, but no harm will be done if the covers are left on for a longer period. The bags are then removed and the soil thoroughly stirred with implements previously sterilised in steam, fire, or formalin, so as to let out the fumes. The stirring process should be repeated several times during the next ten days or a fortnight, after which the seeds may be safely sown.

GENERAL WARNING AGAINST RE-CONTAMINATING DISINFECTED SEED-BEDS.

Great care should always be taken after any soil-sterilising process not to re-contaminate the soil by using undisinfected implements from infected ground, or by walking over the beds with contaminated boots, etc. This is very important, inasmuch as soil-inhabiting disease organisms spread much more rapidly through sterilised than unsterilised soil, owing to the killing off, in the sterilising process, of the other organisms in the ground which would ordinarily compete with or attack them.

CHESHUNT MIXTURE—FOR CHECKING DAMPING-OFF AND ROOT-ROT OF SEEDLINGS.

This mixture was developed by Dr. W. F. Bewley at the Experimental and Research Station of the Nursery and Market Garden Industries' Development Society, at Cheshunt, England, especially to control "damping-off" and root-rotting fungi in tomato seed-beds or -boxes which had not been sterilised, or which had become re-infected by some mischance after the sterilising process. The following extracts from Dr. Bewley's book, "Diseases of Glasshouse Plants," pages 61 and 62, describe the preparation and uses of this substance, which has the great advantage over most other disinfectants that it may be used for watering around the base and roots of growing plants without injuring them:—

"The mixture, which for convenience has been named 'Cheshunt Compound,' consists of *two parts by weight of copper sulphate (bluestone) and eleven parts by weight of ammonium carbonate.*"

"The ammonium carbonate, *which must be fresh,* is reduced to a fine powder by crushing out the lumps. It is then thoroughly mixed with powdered copper sulphate in the correct proportions, and stored for twenty-four hours in a tightly corked glass or stone jar before using."

"The solution is prepared by dissolving one ounce of the dry mixture in a little hot water and adding to two gallons of water. It should not be put into vessels of iron, tin or zinc, as it corrodes them and loses its strength, and just as much as is required for immediate use should be prepared."

"Plants may be watered (around the base) with this solution without injury, while the 'damping-off' organisms in the soil are destroyed, but infected plants receive no benefit, for the fungus is already inside the tissues where the liquid cannot reach it, and such plants eventually die."

To use:—Pull up affected plants, water the soil from which they have been taken, and the ground at the base of the neighbouring plants, with the Cheshunt mixture to prevent attack. In replacing diseased individuals, the method should be to remove the affected plant, water the hole with a pint of solution, replant with a healthy individual, and again water with the solution.

In addition to vegetable-garden plants, Cheshunt mixture has been successfully employed to control *Phytophthora spp.* and similar root- and stem-rotting organisms of Iceland Poppies, Stocks, *Phlox drummondi,* and other flower-garden plants.

HERD TESTING.

THE OFFICIAL AUSTRALIAN PURE BRED DAIRY CATTLE PRODUCTION TESTING SCHEME.

Conducted by Dairy Branch, Department of Agriculture, Western Australia, Year ending 30th June, 1931.

MATURE COWS STANDARD 350 LBS. BUTTER FAT.

Name of Cow.	Owner.	Breed.	Herd Book No.	Age. Yrs.	Age. Mths.	Date of Calving.	No. of Days in Test.	Weight of Milk for Period. lbs.	Average Test. %	Total Butter Fat. lbs.	Weight of Milk last day of Test. lbs.	Sire.
Gentle of Blackheath	E. McManus ...	M.S. ...	11679	10	1	25-10-29	273	16,669	3·82	633·24	41½	Flower's Mayfield of Blackheath. 370
Charming Lass of Greenmount ...	A. J. B. Strempel ...	Jersey ...	20903	5	2	31-7-30	273	8,500	6·28	533·91	18½	Werribee Starbright's King. 2602
Lady Fowler 3rd of Grass Vale ...	R. H. Rose ...	do. ...	19111	5	0	26 5-30	273	10,041	5·22	524·88	22	Rye Duke of Glen Iris, 1994
Koojan Dulcie	A. W. Padbury ...	Guernsey ...	1255	6	4	16 8-30	273	10,281	5·09	24·09	17	Robin of Nundorah, 417
Melba 69th of Darbalara ...	W. G. Burges ...	M.S. ...	...	5	8	7-7-30	273	11,055	4·4	486·42	25	Re Echo of Darbalara, 2254
Matilda 7th of Berry	do.	do. ...	14074	6	8	29-9-30	273	10,725	4·43	474·98	30	Rutland of Darbalara, 575
Topsy Rye of Grass Vale ...	C. H. Ironmonger ...	Jersey ...	15702	7	1	10-8-30	273	8,382	5·64	472·70	14	Rye Duke of Glen Iris, 1994
Charming Bells of Greenmount	A. J. B. Strempel	do. ...	17987	6	3	9-10-30	273	8,514	5·4	460·30	23	Werribee Starbright's King, 2602
Pansy 5th of the Hill	W. G. Burges ...	M.S. ...	...	5	0	5-2-30	273	10,679	4·12	440·79	28	Crescent of the Hill, 2016
Dahlia 5th of Berry	do.	do. ...	...	6	1	14-3-30	273	10,086	4·31	435·13	27	Mirth of Berry, 1716
Buttercup of Ventonia	R. H. Rose ...	Jersey ...	12827	8	2	12-7-30	273	8,544	5·29	452·19	18	Ingot of Banyule, 1413
Sparkle of Trelawney	Miss L. Hancock ...	do. ...	20914	6	4	25-9-30	273	7,548	5·4	407·94	16	Trelawney, 3426
Colleen of Rosewood	Dept. of Agriculture	Guernsey ...	819	8	8	6-10 30	273	7,524	5·37	404·75	18	Archer of Nundorah
Wollongbar Dessie 2nd ...	Muresk College ...	do. ...	1121	6	4	19 8 30	273	7,392	5·45	403·12	19	Renown of Wollongbar, 415
Butterfly of Waterside	Sanatorium Farm ...	M.S. ...	13200	7	7	19-4 30	273	9,426	4·15	391·45	27	Premier of Waterside, 511
Marinora of Tellaraga	A. J. B. Strempel ...	Jersey ...	6707	13	2	31 5-30	240	7,935	4·91	389·70	24	Retford Marifora, 896
Lass of Moorlands	P. Rose	do. ...	8939	9	10	2-4 30	273	7,679	5·07	389·67	16½	Noble's Advance of Garden Hill. 2273
Dinah of Moorlands	do.	do. ...	13528	10	0	15-6-30	273	7,026	5·42	381·06	7	Reveller of Melrose, 1804
Pink Pearl 4th of Mayfield ...	D. Bevan ...	M.S. ...	...	9	10	21-8-30	273	10,953	3·42	375·29	31	Defiance of Oakdale
Lucky Pretty Maid 3rd of East View	A. E. Grant ...	I.M.S. ...	8491	5	2	14-12-29	273	8,254	4·54	374·89	21½	Lucky Boy of East View
Starbright's Duchess of Grass Vale	R. H. Rose ...	Jersey ...	19114	5	8	20-8-30	273	7,506	4·97	373·29	17	Starbright's Sweet Duke of Glen Iris, 3710
Glen Iris Dolly Grey	C. Candy	Friesian ...	2187	5	9	19-6-30	273	10,548	3·49	368·42	31	
Denmark Anne	Dept. of Agriculture	Guernsey ...	1164	5	2	10-5-30	273	6,812	5·37	366·37	17½	Tenwood of Wollongbar, 381
Maid of Moorlands	P. Rose	Jersey ...	20896	8	3	25-4 30	273	7,724	4·65	359·43	13	Reveller of Melrose, 1804
Tessie of Garden Hill	W. Padbury ...	do. ...	17957	5	11	23-8-30	273	6,306	5·69	359·23	17	Cream Socks of Glen Iris 1410
Cowslip 6th of Darbalara ...	W. G. Burges ...	M.S. ...	13348	7	9	3-6 30	273	8,365	4·25	355·58	23½	Windsor of Darbalara, 1444
Lydia of Moorlands	P. Rose	Jersey ...	19107	5	4	20 4-30	273	7,743	4·57	354·09	16	Top Notch of Roelands, 4011
Wollongbar Golden Pearl 5th ...	Muresk College ...	Guernsey ...	1128	5	7	15-4 30	273	5,826	5·85	341·08	17	Judge of Wollongbar, 184
Jewel of Moorlands	P. Rose	Jersey ...	20892	5	1	20 8-30	273	7,018	4·83	339·20	19½	Grafter of Melrose, 3560
Wollongbar Realm 2nd ...	Muresk College ...	Guernsey ...	1151	6	7	29-6-30	273	7,053	4–74	334·71	16	Bellman of Wollongbar, 334
Spurfield Air Girl 2nd	Muresk College ...	Guernsey ...	1048	6	4	8 8 30	273	6,555	5·06	329·27	20	Milton's Steadfast, 292
Lady Fowler 3rd of Bentonia ...	R. H. Rose ...	Jersey ...	17975	6	8	8 7-30	273	6,024	5·23	315·63	13	Ingot of Banyule, 1413
Thelma of Blackheath	H. O. Timms ...	M.S. ...	12847	10	0	15-9-30	240	8,295	3·74	310·74	11	Flower's Mayfield of Blackheath. 370

Makanora of Grass Vale ...	C. H. Ironmonger ...	Jersey ...	12257	7	10	1-5-30	273	7,297	4·19	306·41	17½	Makarine, 995
Denmark Red Rose	Dept. of Agriculture	Guernsey ...	1357	5	2	6-9-30	273	4,863	5·0	291·89	11	Rose Chief of Wollongbar, 130
Grass Vale Fairy Rye ...	C. H. Ironmonger ...	Jersey ...	23689	5	3	11-9-30	273	7,361	3·81	290·84	15½	Rye Duke of Glen Iris, 1994
Violet 1st of Glen Avon ...	D. Bevan	M.S. ...	...	5	10	18 7-30	273	8,083	3·54	286·69	19½	Premier of Blackheath, 1740
Melba 42nd of Darbalara ...	W. G. Burges ...	do. ...	12134	8	6	12-2-30	150	5,985	4·73	283·23	36	Limelight of Darbalara, 1105
Boronia Rye of Grass Vale ...	C. H. Ironmonger ...	Jersey ...	17529	6	8	8 4 30	240	6,675	3·94	263·10	19	Rye Duke of Glen Iris, 1994
The Flower of Lilyarup ...	H. O. Timms ...	M.S. ...	14747	8	0	15-4-30	240	6,840	3·83	262·26	12	Earl of Blackheath, 967
Vanity 8th of Oakdale ...	do.	do. ...	12931	10	4	4 4 30	210	6,465	3·98	257·52	14½	Standard of Oakdale, 226
Mabel of Oakleigh	D. Bevan	do. ...	...	7	4	6-5-30	273	7,178	3·55	254·77	19½	Garfield of Oakleigh, 1623
Granton Lydia	C. Candy	Freisian ...	1560	6	8	14-5-30	210	6,645	3·58	237·81	25	
Pentland Blossom 4th of Claremont	Hospital for Insane	M.S. ...	15069	6	11	1-7 30	210	6,285	3·78	237·66	10½	Telyarup Prince of Claremont, 2352
Della 11th of Oakdale	H. O. Timms ...	do. ...	9355	Aged		18-10-30	240	5,985	3·92	234·54	10½	
Maggie Morrisson 2nd of Claremont	Hospital for Insane	do. ...	...	8	2	28-1-30	240	6,195	3·62	224·22	13	Norval of Darbalara
Jessica of Grass Vale	A. Piele	Jersey ...	15693	7	6	3-4 30	210	5,325	4·18	222·72	13	King George of Yarralla, 1271
Milkmaid 1st of Blackheath ...	H. O. Timms ...	M.S. ...	10091	12	2	21 9-30	240	5,880	3·62	213·36	7½	Flower's Mayfield of Blackheath, 370
Ullery 5th of Kelvin Park ...	Hospital for Insane	do. ...	...	6	7	2-6-30	273	5,185	4·09	212·34	13½	Daddy Xmas of Croolyar, 928
Koojan Dolly	A. W. Wilson ...	Guernsey ...	1454	5	4	3 10-30	240	5,160	3·89	201·12	13½	Robin of Nundorah, 417
Famous 2nd of Mayfield ...	D. Bevan	M.S. ...	...	9	4	19 3 30	273	5,203	3·7	192·52	14½	Model's Lad of Mayfield, 1158
Wollongbar Bonnie Pearl ...	Dept. of Agriculture	Guernsey ...	1165	6	7	18 1-31	150	3,915	4·85	190·05	24⅜	Bounty of Wollongbar, 336
Capture of Grass Vale	A. Piele	Jersey ...	19109	5	4	12-9 30	150	3,675	4·4	161·70	17¼	Rye Duke of Glen Iris, 1994
Denmark Rose Pearl	Dept. of Agriculture	Guernsey ...	1430	5	1	7 12-30	180	2,745	5·52	152·64	13½	Rose Chief of Wollongbar, 130
Starbright's Duchess of Glen Iris	Mrs. B. Burnside ...	Jersey ...	14176	7	1	15-10 30	90	2,595	5·07	131·76	15½	Sweetbread's Duke of Glen Iris, 1918
Golden Noble Princess of Glen Iris	W. Padbury ...	do. ...	12965	7	8	2-4-30	150	2,315	5·36	124·26	11	Mercedes Prince of Glen Iris, 1917
Spurfield Alma	Muresk College ...	Guernsey ...	1049	5	5	13 4 30	120	2,520	4·6	116·22	21	Milton's Steadfast, 292
Boronia of Grass Vale	A. Piele	Jersey ...	9994	11	3	27-11-30	60	1,785	3·28	58·62	26½	Noble's Best of Garden Hill, 2268
COWS OVER 4½ YEARS AND UNDER 5 YEARS—STANDARD 330 LBS. BUTTER FAT.												
Royal Lady of Kurrawong ...	W. G. Burges ...	M.S. ...	...	4	9	16 1 30	273	10,635	4·0	426·05	28½	Count Hughes of Cosey Camp, 2011
Bo Peep of Greenmount ...	A. J. B. Strempel ...	Jersey ...	20902	4	11	21 6-30	273	7,521	5·52	400·60	22	Werribee Starbright's King, 2602
Silvermine 2nd of Garden Hill ...	W. Padbury ...	do. ...	20879	4	11	22-10 30	273	6,993	5·47	382·58	21	Cream Socks of Glen Iris, 1410
Beryl of Moorlands	P. Rose	do. ...	20886	4	11	5 6-30	273	8,640	4·24	366·56	15	Grafter of Melrose, 3560
Sweet Duchess of Grass Vale ...	R. H. Rose ...	do. ...	23692	4	11	9-8 30	273	6,195	5·57	345·31	10	Starbright's Sweet Duke of Glen Iris, 3710
Hazel of Moorlands	P. Rose	do. ...	20891	4	9	24 4-30	273	6,840	4·62	316·25	15	Grafter of Melrose, 3560
Denmark Rosa	Dept. of Agriculture	Guernsey ...	1429	4	7	13-7 30	273	5,990	5·25	314·61	13½	Rose Chief of Wollongbar, 130
Bemil of Moorlands	P. Rose	Jersey ...	20885	4	7	22 4-30	273	6,663	4·76	314·19	16	Colonel of Melrose, 4015
Bud of Moorlands	do.	do. ...	20888	4	8	29-4-30	273	5,772	4·93	284·98	14	Grafter of Melrose, 3560
Biddy 6th of Claremont ...	Hospital for Insane	M.S. ...	...	4	7	23 5-30	273	5,490	3·96	217·54	10	Telyarup Prince of Claremont, 2352
COWS OVER 4 YEARS AND UNDER 4½ YEARS—STANDARD 310 LBS. BUTTER FAT.												
Koojan Wavelet	A. W. Padbury ...	Guernsey ...	1619	4	1	18-9 30	273	8,610	5·06	435·78	20	Robin of Nundorah, 417
Maggie of Claremont	Hospital for Insane	M.S. ...	...	4	5	30 8-30	273	11,497	3·75	431·77	22½	Searchlight of Sunnyvale, 2302
Kathleen 5th of Kurrawong ...	W. G. Burges ...	do. ...	...	4	3	6-3 30	273	10,110	4·15	419·66	25	Premier of Kurrawong, 1212
Daphne 7th of the Hill ...	do.	do. ...	...	4	5	5 10-30	273	10,248	4·08	418·11	31	Crescent of the Hill, 2016
Pride 4th of Kurrawong ...	do....	do. ...	...	4	3	20 2 30	273	10,028	3·98	399·60	24½	Premier of Kurrawong, 1212
Moorlands Ada	P. Rose	Jersey ...	23679	4	1	12-6-30	273	7,038	5·09	358·87	11	Colonel of Melrose, 4015
Moorlands Agnes	do.	do. ...	23680	4	1	17-7-30	273	7,593	4·86	369·08	16	Colonel of Melrose, 4015
Moorlands Anne	do.	do. ...	23686	4	3	4 9 30	273	6.394	5·27	337·28	11½	Colonel of Melrose, 4015

HERD TESTING—*continued.*

Name of Cow.	Owner.	Breed.	Herd Book No.	Age.		Date of Calving.	No. of Days in Test.	Weight of Milk for Period.	Average Test.	Total Butter Fat.	Weight of Milk Last day of Test.	Sire.
				Yrs.	Mths.			lbs.	%	lbs.	lbs.	
COWS OVER 4 YEARS AND UNDER 4½ YEARS—STANDARD 310 LBS. BUTTER FAT—*continued.*												
Mokine Heroine 3rd	T. H. Wilding ...	Jersey ...	...	4	2	6-9-30	273	6,108	5·14	314·00	6	Mokine Hood, 4925
Nooka Queen	T. P. Herbert ...	do. ...	23664	4	5	1-7-30	273	6,691	4·52	302·35	15½	Jessie's King of Sarnia, 4578
Lady Fowler 6th of Grass Vale	R. H. Rose ...	do. ...	24928	4	1	30-7-30	273	5,781	5·22	301·81	12	Carnation's Masterpiece of Garden Hill
Moorlands Alma	P. Rose	do. ...	23684	4	1	18-9-30	273	5,925	4·88	289·40	15	Colonel of Melrose, 4015
Koojan Lady Buller	A. W. Wilson ...	Guernsey ...	1259	4	4	3-11-29	273	5,286	5·33	282·25	12	Robin of Nundorah, 417
Koojan Dolly	do.	do. ...	1254	4	4	2-11 29	273	6,504	4·12	268·49	18	Robin of Nundorah, 417
Mokine Empire Lily 9th ...	T. H. Wilding ...	Jersey ...	...	4	4	24-9-30	273	4,530	5·5	249·45	10	Mokine Hood, 4925
Clara 3rd of Claremont ...	Hospital for Insane	M.S. ...	...	4	1	23-8-30	273	5,901	4·11	242·49	12	Telyarup Prince of Claremont, 2352
Whitby Maid 5th of Claremont	do. do. ...	do. ...	...	4	5	21-9-30	210	5,460	4·34	237·00	15½	Searchlight of Sunnyvale, 2302
Minnamurri Fairy Queen ...	Giblett & Johnston	Guernsey ...	1592	4	2	1-8-30	180	4,030	5·35	217·03	11½	Minnamurra Golden Lad, 402
Pet 5th of Kurrawong	A. E. Grant ...	M.S. ...	...	4	0	10-8-30	150	5,220	3·89	202·62	24½	Premier of Kurrawong, 1212
COWS OVER 3½ YEARS AND UNDER 4 YEARS—STANDARD 290 LBS. BUTTER FAT.												
Koojan Bonnie Jean	A. W. Padbury ...	Guernsey ...	1612	3	8	14-11 29	273	9,462	5·75	544·50	29	Robin of Nundorah, 417
Koojan Ida	do.	do. ...	1900	3	7	2-9-30	273	7,632	5·28	403·06	19	Robin of Nundorah, 417
Moorlands April	P. Rose	Jersey ...	23687	3	9	5-6-30	273	7,776	4·99	388·25	12	Colonel of Melrose, 4015
Colwyn's Lady	C. H. Ironmonger ...	do. ...	23667	3	7	13-8 30	273	8,581	4·36	374·46	20½	Roelands Milord, 5611
Koojan Bluebell	A. W. Wilson ...	Guernsey ...	1674	3	8	12-4-30	273	6,302	5·56	350·52	17½	Robin of Nundorah, 417
Juadine Dianthus 2nd	Miss L. Hancock ...	Jersey ...	23713	3	11	18-6 30	273	5,665	5·66	320·97	13½	Noble's Best of Garden Hill, 1756
Muresk Lily	Muresk College ...	Guernsey ...	1801	3	7	29-8-30	273	5,874	5·22	306·93	18	Wollongbar Triumph, 513
Juadine Sparkle	Miss L. Hancock ...	Jersey ...	24716	3	7	22 3 30	273	6,270	4·79	300·87	20	Juadine Fop, 4797
Diamond 3rd of Raleigh ...	D. Bevan	M.S. ...	...	3	11	16-10-30	273	7,740	3·85	298·11	10	Union Jack of Raleigh, 2375
Gold X of Raleigh	do.	do. ...	...	3	7	9-6-30	273	7,455	3·95	296·11	10	Pacifist of Raleigh, 1731
Spring Park Rye Queen ...	C. H. Ironmonger ...	Jersey ...	23657	3	7	14 2-30	273	6,015	4·85	291·80	20	Rye Duke of Glen Iris, 1994
Moorlands Petty	P. Rose	do. ...	24922	3	8	18-8-30	273	5,601	5·2	291·34	12	Grafter of Melrose, 3560
Wollongbar Betty 2nd	Muresk College ...	Guernsey ...	1571	3	9	17-4-30	273	5,208	5·51	287·07	16	Bounty of Wollongbar, 336
Venus 7th of Raleigh	D. Bevan	M.S. ...	...	3	8	29-6-30	273	7,926	3·57	283·69	17	Union Jack of Raleigh, 2375
Ethel 13th of Raleigh	do.	do. ...	...	3	10	14-7-30	273	6,711	4·02	269·67	22	Barrister of Raleigh
Garden Hill Ice Cream 2nd ...	W. Padbury ...	Jersey ...	24712	3	7	25-7-30	273	4,114	6·34	261·19	6½	Cream Socks of Glen Iris, 1410
Minnamurra Joyce	Giblett & Johnston	Guernsey ...	1866	3	11	3-9-30	273	5,484	4·68	256·72	8	Minnamurra Golden Lad, 402
Crantock's Lady Lily	Mrs. B. Burnside ...	Jersey ...	24705	3	7	21-5-30	240	4,755	4·96	235·20	10½	Starbright's Sweet Duke of Glen Iris, 3710
Beanie 2nd of Claremont ...	Hospital for Insane	M.S. ...	...	3	10	11-3-30	273	5,347	3·5	187·42	12½	Starbright's Sweet Duke of Glen Iris, 3710
Grass Vale Sweet Maggie ...	A. Piele	Jersey ...	23677	3	9	30-5-30	240	3,255	4·59	149·43	6	Starbright's Sweet Duke of Glen Iris, 3710
Minnamurra Judith	Giblett & Johnston	Guernsey ...	1867	3	11	17-9-30	90	2,265	5·07	114·76	22½	Judge of Wollongbar, 184

COWS OVER 3 YEARS AND UNDER 3½ YEARS—STANDARD 270 LBS. BUTTER FAT.

Kitty 8th of Kurrawong ...	W. G. Burges ...	M.S. ...	...	3	4	17-12-29	273	9,814	4·82	473·26	31½	Premier of Kurrawong, 1212
Greenmount Charming Bells 3rd	A. J. B. Strempel ...	Jersey ...	24934	3	4	17-7-30	273	7,332	5·28	387·47	19	Werribee Starbright's King, 2602
Moorlands Biddy	P. Rose	do. ...	24915	3	2	10-7-30	273	7,240	5·33	386·20	15	Colonel of Melrose, 4015
Wing Wing of Wooroloo ...	Sanatorium Farm ...	M.S. ...	...	3	4	24-10-29	273	9,160	3·76	345·25	28½	Eclipse of Wooroloo
Muresk Buttercup	Muresk College ...	Guernsey ...	1799	3	4	15-8-30	273	6,615	5·15	340·67	20	Triumph of Wollongbar, 513
Grass Vale Montrose Maid	R. H. Rose ...	Jersey ...	24929	3	4	8 10 30	273	6,348	5·32	337·97	16	Montrose East of Glen Iris, 4140
Star of Claremont	Hospital for Insane	M.S. ...	...	3	4	24 9 30	273	8,709	3·8	331·15	18	Telyarup Prince of Claremont, 2352
Muresk Carnation	Muresk College ...	Guernsey ...	1800	3	3	17-8-30	273	6,471	4·98	322·40	17	Triumph of Wollongbar, 513
Picture 8th of Raleigh ...	D. Bevan	M.S. ...	...	3	5	16-9 03	273	8,048	3·88	312·56	24½	Union Jack of Raleigh, 2375
Moorlands Brenda	P. Rose	Jersey ...	24919	3	1	18 7 30	273	6,417	4·77	306·43	14	Grafter of Melrose, 3560
Grass Vale Montrose Nora ...	R. H. Rose ...	do. ...	24930	3	1	26 8 30	273	5,270	5·77	304·53	8½	Montrose East of Glen Iris, 4140
Muresk Pansy	Muresk College ...	Guernsey ...	1802	3	3	4-9-30	273	4,638	6·09	282·36	16	Triumph of Wollongbar, 513
Cherry 1st of Claremont ...	Hospital for Insane	M.S. ...	...	3	5	1-8-30	273	6,938	4·05	281·05	21½	Telyarup Prince of Claremont, 2352
Bellefaire Spotted Socks ...	Mrs. B. Burnside ...	Jersey ...	26745	3	1	27 3 30	273	4,977	5·43	270·16	9	Werribee Prince Twylish, 2396
Nancy 9th of Raleigh	D. Bevan	M.S. ...	...	3	5	8-9-30	273	6,111	4·4	268·98	7	Union Jack of Raleigh, 2375
Denmark Red Rose 2nd ...	Dept. of Agriculture	Guernsey ...	1792	3	1	17-11 29	273	4,800	5·28	253·66	15	Rose Chief of Wollongbar, 130
Elsie 4th of Raleigh	D. Bevan	M.S. ...	...	3	5	10-7-30	273	6,641	3·58	238·33	17	Union Jack of Raleigh, 2375
Denmark Gladys	Dept. of Agriculture	Guernsey ...	1790	3	2	15-5-30	180	3,885	5·69	221·19	14	Rose Chief of Wollongbar, 130
Minnamurra Millicent	Giblett & Johnston	do. ...	1872	3	0	31-10 29	273	5,115	4·16	213·01	15	Minnamurra Golden Lad, 402
Rachel 4th of Claremont ...	Hospital for Insane	M.S. ...	...	3	2	18-7-30	273	6,204	3·37	202·99	13	Searchlight of Sunnyvale, 2302
Treasure of Claremont	do. do. ...	do. ...	15072	3	1	17-10 29	273	5,850	3·23	188·94	5	Lord Oliver of Homeleigh
Cleggett 2nd of Claremont ...	do. do. ...	do. ...	...	3	2	25-12-29	273	4,618	4·05	187·17	9½	Telyarup Prince of Claremont, 2302
Wollongbar Rachel	Muresk College ...	Guernsey ...	1572	3	4	29-11-29	273	3,526	5·27	185·81	10½	Bounty of Wollongbar, 336
Minnamurra Lady Love ...	Giblett & Johnston	do. ...	1869	3	5	10-8-30	180	3,255	5·10	166·26	11	Minnamurra Viscount, 682

HEIFERS OVER 2½ YEARS AND UNDER 3 YEARS—STANDARD 250 LBS. BUTTER FAT.

Sally of the Hill	W. G. Burges ...	M.S. ...	...	2	7	29 5-30	273	9,936	4·11	408·43	27	Crescent of the Hill, 2016
Spring Park Starbright's Queen	A. W. Padbury ...	Jersey ...	24901	2	7	22 10 30	273	7,473	5·27	393·94	21	Prince Marinora of Grass Vale, 4582
Denmark Rose Dame	Dept. of Agriculture	Guernsey ...	1794	2	7	25-3-30	273	7,948	4·94	393·23	19½	Rose Chief of Wollongbar, 130
Minnamurra Judy	Giblett & Johnston	do. ...	1868	2	11	28-2 30	273	5,607	5·68	319·06	19	Judge of Wollongbar, 184
Denmark Rose Pearl 3rd ...	Dept. of Agriculture	do. ...	1798	2	9	20-8-30	273	5,310	5·83	309·50	15	Rose Chief of Wollongbar, 130
Denmark Rose Pearl 2nd ...	do. do. ...	do. ...	1797	2	9	27-9-29	273	8,613	5·51	309·31	21	Rose Chief of Wollongbar, 130
Mokine Empire Lily 12th ...	T. H. Wilding ...	Jersey ...	24946	2	10	5-9-30	273	4,065	7·35	298·72	10	Noble's Best of Garden Hill
Moorlands Blue	P. Rose	do. ...	24918	2	11	18-8-30	273	5,584	5·1	285·68	11½	Grafter of Melrose, 3560
Moorlands Blot	do.	do. ...	24917	2	11	13 8-30	273	5,562	5·09	283·56	12½	Zenith of Moorlands, 4581
Minnamurra Lady Love ...	Giblett & Johnston	Guernsey ...	1869	2	8	19-10-29	273	5,526	4·88	269·63	17	Minnamurra Viscount, 682
Moorlands Bijou	P. Rose	Jersey ...	24916	2	11	20-8-30	273	5,298	5·09	266·96	11	Grafter of Melrose, 3560
Cherry 2nd of Claremont ...	Hospital for Insane	M.S. ...	...	2	7	13-8 30	273	5,750	4·44	255·44	18	Telyarup Prince of Claremont, 2352
Nooka Pearl	T. P. Herbert ...	Jersey ...	...	2	9	15-9-30	237	4,708	5·4	254·25	9½	Jessie's King of Sarnia, 4578
Roslyn 2nd of Raleigh ...	D. Bevan	M.S. ...	...	2	9	29-7-30	273	6,336	4·0	253·82	22	Union Jack of Raleigh, 2375

HEIFERS OVER 2½ YEARS AND UNDER 3 YEARS—STANDARD 250 LBS. BUTTER FAT.

Koojan Gem	A. W. Wilson ...	Guernsey ...	1982	2	7	29-10 29	273	5,329	4·73	252·17	16½	Koojan Golden Governor, 595
Famous Star of Glen Avon ...	D. Bevan	M.S. ...	...	2	7	12-3-30	273	6,202	4·04	250·99	17½	Premier of Blackheath
Rachel 5th of Claremont ...	Hospital for Insane	do. ...	...	2	7	17-9-30	273	5,889	3·68	216·70	18	Refrain of Darbalara
Spring Park Sweet Ginger ...	W. Padbury ...	Jersey ...	24903	2	7	18-3-30	273	3,906	5·06	197·60	12	Prince Marinora of Grass Vale, 4582
Colmyn's Veronica	C. H. Ironmonger ...	do. ...	24899	2	8	15-9-30	273	4,183	4·72	197·44	9½	Roeland's Milord, 5611
Whitby Maid 6th of Claremont	Hospital for Insane	M.S. ...	...	2	11	27-5-30	240	4,920	3·67	180·57	11	Searchlight of Sunnyvale, 2302
Dolly of Brush Grove	R. H. Rose ...	do. ...	...	2	11	16-11-29	210	3,690	3·17	116·85	17½	Ardee of the Hill
Coral II. of Brush Grove ...	do.	do. ...	...	2	8	6-12-29	180	3,045	3·81	116·01	18½	Ardee of the Hill

HERD TESTING—*continued.*

Name of Cow.	Owner.	Breed.	Herd Book No.	Age.	Date of Calving.	No. of Days in Test.	Weight of Milk for Period.	Average Test.	Total Butter Fat.	Weight of Milk Last day of Test.	Sire.
HEIFERS UNDER 2½ YEARS—STANDARD 230 LBS. BUTTER FAT.				Yrs. Mths.			lbs.	%	lbs.	lbs.	
Red Rose of Wooroloo ...	Sanatorium Farm ...	M.S. ...	...	2 4	27-6-30	273	9,128	4·18	382·53	26	Triumph of Pine Creek, 2515
Limelight's Camelia of Wangara	W. G. Burges ...	do. ...	...	2 5	17-12-29	273	8,250	4·26	351·49	30	Limelight of Darbalara, 1105
Victress of Toora	do.	do. ...	...	2 5	20-8-30	273	7,455	4·63	345·30	10	Victor of Darbalara, 2384
Denmark Rose Marie ...	Dept. of Agriculture	Guernsey ...	1796	2 5	27 3-30	273	6,000	5·52	331·31	15	Wollongbar Reformer, 538
Koojan Trequean Fanny ...	A. W. Padbury ...	do. ...	2334	2 1	24 9 30	273	6,504	5·03	327·17	18	Koojan Golden Governor, 595
Moorlands Chloe	P. Rose	Jersey ...	...	2 0	18-5-30	273	6,102	5·33	325·56	14	Colonel of Melrose, 4015
Juadine Belvedere	Miss L. Hancock ...	do. ...	...	2 1	4 6-30	273	5,976	5·37	320·89	17	Mokine Hero
Juadine Sparkle 2nd	do. do. ...	do. ...	...	2 3	9-8-30	273	6,456	4·9	316·43	17	Mokine Hero
Colmyn's Topaz Girl	C. H. Ironmonger ...	do. ...	24898	2 4	13-11-29	273	5,840	5·35	312·73	18½	Roelands Milord, 5611
Empress 4th of the Hill ...	W. G. Burges ...	M.S. ...	...	2 4	6 10-30	273	7,608	4·1	312·09	21	Crescent of the Hill, 2016
Moorlands Camelia	P. Rose	Jersey ...	...	2 0	26 6-30	273	6,508	4·69	305·69	9½	Colonel oj Melrose, 4015
Muresk Rose	Muresk College ...	Guernsey ...	...	2 1	10-6-30	273	5,313	5·59	297·47	16	Triumph of Wollongbar
Juadine Peerless Lily 3rd ...	Miss L. Hancock ...	Jersey ...	...	2 0	24 9 30	273	5,394	5·5	296·25	13	Sonny of Juadine
Lady Fowler 9th of Grass Vale ...	R. H. Rose ...	do. ...	...	1 11	22-5 30	273	5,452	5·43	296·10	12½	Mokine Christopher Columbus, 1999
Spangle 8th of the Hill ...	W. G. Burges ...	M.S. ...	...	2 5	2-10-30	273	6,471	4·53	293·34	17	Crescent of the Hill, 2016
Koojan Daffodil	A. W. Padbury ...	Guernsey ...	2231	1 11	13 9-30	273	5,070	5·77	292·87	15	Koojan Golden Governor, 595
Muresk Daisy	Muresk College ...	do. ...	2155	2 2	10-8-30	273	6,210	4·65	289·17	20	Wollongbar Triumph, 513
Spring Park Dora	C. H. Ironmonger ...	Jersey ...	24900	2 0	12 3-30	273	5,698	4·98	283·78	19½	Prince Marinora of Grass Vale, 4582
Moorland Cushy	P. Rose	do. ...	...	2 0	10-5-30	273	5,690	4·94	283·04	13½	Colonel of Melrose, 4015
Denmark Pamelia	Dept. of Agriculture	Guernsey ...	1791	2 5	26-3-30	273	4,872	5·73	279·20	14	Rose Chief of Wollongbar, 130
Mokine Heroine 5th	T. H. Wilding ...	Jersey ...	...	1 11	7 9-30	273	5,691	4·87	277·42	12	Twylish Fox of the Valley, 5623
Juadine Juliet 5th	Miss L. Hancock ...	do. ...	...	2 1	22-9-30	273	5,103	5·28	269·46	11	Mokine Hero
Mokine Empire Lily 13th ...	T. H. Wilding ...	Jersey ...	...	1 10	5-9-30	273	5,004	5·33	267·03	13	Twylish Fox of the Valley, 5623
Camellia of Tipperary	W. G. Burges ...	M.S. ...	...	1 7	21 3 30	273	6,234	4·27	266·50	13	Searchlight of Darbalara
Moorlands Cherry	P. Rose	Jersey ...	...	2 1	11-6-30	273	5,355	4·91	263·07	10	Colonel of Melrose, 4015
Colmyn's Veronica	C. H. Ironmonger ...	do. ...	24899	1 10	10 11-29	273	5,273	4·94	261·43	17½	Roelands Milord, 5611
Muresk Violet	Muresk College ...	Guernsey ...	2157	2 1	1 8-30	273	5,115	5·09	260·58	15	Wollongbar Triumph, 513
Moorlands Cora	P. Rose	Jersey ...	...	2 4	16-6-30	240	5,070	5·10	260·07	11½	Grafter of Melrose, 3560
Juadine Sparkle, 3rd	Miss L. Hancock ...	Jersey ...	...	1 10	12-7-30	273	5,190	4·95	256·31	15	Twylish Fox of the Valley, 5623
Nooka Carnation	S. P. Herbert ...	do. ...	...	2 4	10 9-30	273	5,071	5·04	255·69	10½	Jessie's King of Sarnia, 4578
Denmark Rose Lady	Dept. of Agriculture	Guernsey ...	1795	2 2	26-10 29	273	4,755	5·37	255·62	15	Rose Chief of Wollongbar, 130
Venus 8th of Raleigh	D. Bevan	M.S. ...	...	2 3	5-5 30	273	7,152	3·55	254·26	19	Royal Standard of Darbalara
Gold XI. of Raleigh	do.	do. ...	...	2 5	9-3 30	273	6,561	3·76	246·86	22	Standard of Darbalara
Mokine Twylish Columbine ...	T. H. Wilding ...	Jersey ...	...	1 10	12 9-30	273	4,458	5·48	244·59	11	Twylish Fox of the Valley, 5623
Matilda of Tipperary	A. E. Grant ...	M.S. ...	...	2 0	27-3-30	273	5,436	4·45	242·35	12	Villiers of Darbalara
Crantock's Starbright's Rose ...	Mrs. B. Burnside ...	Jersey ...	...	1 10	25-4-30	273	4,017	6·0	241·38	9	Crantock Starbright's Chief, 5740
Melba 1st of Tipperary ...	W. G. Burges ...	M.S. ...	...	2 1	11 10 29	273	5,064	4·71	238·96	18	Villiers of Darbalara
Muresk Pansy	Muresk College ...	Guernsey ...	1802	2 4	25-10 29	273	4,491	5·18	233·02	17	Wollongbar Triumph, 513
Spring Park Starbright's Queen	W. Padbury ...	Jersey ...	24901	1 9	6-12 29	273	4,554	5·07	231·31	13	Prince Marinora of Grass Vale, 4582
Virginia 1st of Tipperary ...	A. E. Grant ...	M.S. ...	17903	1 8	26-3-30	240	4,905	4·62	226·83	13	Villiers of Darbalara
Colmyn's Princess	C. H. Ironmonger ...	Jersey ...	24896	2 2	8 7-30	273	4,623	4·85	224·59	11	Prince Marinora of Grass Vale, 4582
Della 1st of Tilyarup	A. E. Grant ...	M.S. ...	...	1 11	18-10-30	273	5,749	3·89	223·75	16½	Baron of Darbalra
Mavis 2nd of Claremont ...	Hospital for Insane	do. ...	...	2 5	11 8 30	273	5,373	4·13	222·20	16	Telyarup Prince of Claremont, 2352
Colmyn's Princess Marinora ...	C. H. Ironmonger ...	Jersey ...	24897	2 4	17-9-30	273	4,657	4·7	219·18	12½	Prince Marinora of Grass Vale, 4582

Karridale Kathleen	A. W. Wilson ...	Guernsey ...	1979	1	11	30–10–29	273	4,305	5·08	219·04	10	Minnamurra Oliver Twist, 528
Beanie 3rd of Claremont ..	Hospital for Insane	M.S. ...	...	2	0	11–8–30	273	5,535	3·94	218·07	20	Duncan of Claremont, 2467
Karridale Pride	A. W. Wilson ...	Guernsey ...	1981	4	1	28–10–29	273	4,801	4·54	217·95	15½	Minnamurra Oliver Twist, 528
Denmark Irish Rose	Dept. of Agriculture	do. ...	2154	1	10	30 8 30	273	3,705	5·75	216·84	10	Rose Chief of Wollonglar, 130
Hilda 3rd of Claremont ...	Hospital for Insane	M.S. ..	...	2	2	9–3–30	273	5,272	4·09	215·77	12½	Searchlight of Sunnyvale
Gwen 2nd of East View .	A. E. Grant ...	I.M.S. ...	...	1	11	12 8 30	273	5,592	3·72	208·06	14	Mariner of Greyleigh
Laura 2nd of Claremont ..	Hospital for Insane	M.S. ...	...	2	2	21 2–30	273	5,260	3·92	206·33	18½	Telyarup Prince of Claremont, 2352
Pendant of East View	A. E. Grant ...	I.M.S. ...	...	2	0	19–6–30	273	5,263	3·72	197·16	4½	Sultan of East View
Maggie Morrison 7th of Claremont	Hospital for Insane	M.S. ..	...	2	0	7–2–30	273	5,286	3·72	196·88	17	Telyarup Prince of Claremont, 2352
Beauty 7th of Claremont ...	do. do. ...	do. ...	...	2	5	20–8–30	273	4,836	4·02	194·66	17	Telyarup Prince of Claremont, 2352
Crantock Cream Star	Mrs. B. Burnside ...	Jersey .	...	1	9	20–5–30	273	3,222	6·06	194·50	4	Crantock's Starbright's Chief, 5790
Maggie Morrison 6th of Claremont	Hospital for Insane	M.S. .	...	2	1	5–1–30	273	4,986	3·81	189·97	12	Searchlight of Sunnyvale, 2302
Biddy 9th of Claremont ...	do. do. ...	do. ...	...	2	0	5–8–30	273	4,754	3·94	187·63	16½	Clinker of Claremont, 2465
Bonny of Tipperary	W. G. Burges ...	do. .	...	2	4	8–5 30	180	4,320	4·35	187·62	20½	Triumph of Berry
Princess Molly 2nd of Claremont	Hospital for Insane	do. .	...	2	0	8 8 30	273	4,263	4·35	185·54	16	Duncan of Claremont, 2467
Karridale Lady Biddy	A. W. Wilson ...	Guernsey ...	2323	1	5	3 3 30	273	4,078	4·33	176·89	14½	Minnamurra Oliver Twist, 528
Mokine Ruby	T. H. Wilding ...	Jersey ...	...	2	0	29 9–30	273	3,061	5·73	175·53	7	Mokine Hood, 4925
Virginia 2nd of Tipperary ..	A. E. Grant ...	M.S. ...	...	1	11	11 8 30	273	4,101	4·18	171·74	12	Villiers of Barbalara
Pansy of Tipperary ...	do.	do. ...	..	1	9	4 9 30	273	4,200	4·03	169·41	15	Villiers of Barbalara
Sundae of Glen Avon	D. Bevan	do. ...	...	2	5	10 8 30	273	4,326	3·90	169·08	12	Premier of Blackheath
Moorlands Catronia	P. Rose	Jersey ..	...	1	10	24 4 30	180	3,435	4·86	167·19	21	Grafter of Melrose, 3580
Avoncourt Jessie	A. Piele	do. ...	25070	1	11	11–3 30	240	2,925	4·66	136·39	11½	Lily's Prince of Grass Vale, 5179
Nooka Wild Rose ...	T. P. Herbert ...	do. ..	...	1	9	21 9 30	120	2,310	4·24	98·10	18½	Montrose East of Glen Iris, 4140
Avoncourt Marguerite	A. Piele	do. ..	25071	2	4	9 11 30	90	2,075	4·25	88·29	19½	Lily's Prince of Grass Vale, 5179
Floretta 4th of Claremont ...	Hospital for Insane	M.S. ...	...	2	3	25–11–30	120	1,935	3·74	72·42	13½	Clinker of Claremont, 2456
Nooka Pride	S. P. Herbert ...	Jersey ...	...	1	9	1 10 30	90	1,365	4·41	60·31	14½	Jessie's King of Sarnia, 4578

TOBACCO.

NOTES FOR INTENDING GROWERS.

A. R. C. Clifton,
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The objective in growing tobacco is to produce a leaf having those desirable smoking qualities and colour which would enable it to be used for manufacturing purposes. The trade demands a bright coloured flue-cured leaf, possessing a mild and not objectionable aroma with good burn. These qualities are primarily influenced by soil and climate.

SOIL.

The tobacco plant, when once established, is hardy and will grow under a wide range of different soils and climatic conditions. Commercial tobacco, however, is not only exacting as to its requirements regarding the texture, colour and condition of the soil on which it is grown, but also in the necessary care and constant attention required during the growing period and in the process of curing. Flue-cured types are produced on a rather poor, light coloured sand, or loamy sand, and a better leaf is produced on the slopes than on the flats. Good drainage is absolutely essential.

Leaf produced on rich fertile soils or moist swamp land of either a heavy or light texture, possesses undesirable qualities which make it of little commercial value. The same applies to black sand or any soils which become waterlogged in winter.

Before spending any money in attempting to grow tobacco in localities which have not already been proved, it is first advisable to experiment on a small scale with a few plants. Only an actual test will determine if the soil is suitable for the production of tobacco with desirable qualities.

CLIMATE.

The growing period is during that part of the year when frosts are absent, *i.e.*, spring and summer. It is, therefore, necessary to have 6 or 7 inches of rain and freedom from frosts during such period.

Tobacco being a summer-growing plant, its cultivation under natural conditions must be confined to districts having a sufficient spring and summer rain, and to soils in which cultivation will retain sufficient moisture to promote steady and very regular development of the plant without check to its growth.

As this is a State of light average summer rainfall, it is important to have the seedling plants ready for planting out as early in the season as possible, say, September, or as soon as the danger of frost is over. This has been very clearly indicated in the tests carried out around Manjimup, and the results of last season's crop further emphasise the point. Last year's experience showed that the tobacco plant will grow with very little rain, for at Manjimup only 337 points fell between planting and harvesting of the experimental plots; but with such light rainfall the quality of the leaf suffered badly through insufficient moisture. Just what is the minimum satisfactory rainfall under South-West conditions for the tobacco plant has not yet been determined, but obviously the figure must vary with the nature of the soil. Soils that will retain their moisture through cultivation will require less

rain to produce a good quality leaf than soils which dry out more quickly. One point in the cultivation of tobacco which should be stressed is that while the plant may survive a check and show no visible ill-effects, any interruption of normal growth depreciates the quality of the leaf. A humid atmosphere is very desirable, especially dewy nights when the plant is reaching maturity.

VARIETIES.

"Hickory Pryor," "Conqueror," "White Stem Orinoco," "Adcock" and "Warne" are all suitable for flue-curing.

SEED BEDS.

Particular care and attention is necessary in raising the seedlings in Western Australia, as our light summer rainfall makes it important to plant out as early as possible in the spring so as to catch the full benefit from the late spring rains. This means that the seed beds must be put down in winter. The best results in the South-West have been obtained by planting out in September, which means starting the seed beds at the beginning of July. The site of the seed bed should be carefully selected so as to catch as much sun as possible. It should therefore have a Northerly aspect, combined with good natural drainage. A dark sandy loam will be found most suitable.

Before sowing, the soil of which the seed bed is to be made should be sterilised. The simplest method of doing this is to burn the soil with a slow fire made of brush and wood until well burned. This will kill all weed seeds, disease spores, and clear the soil of insect pests. After the fire, all unburnt portions are raked off and the remaining ashes, together with 1 lb. per square yard of some good complete fertiliser, should be lightly worked into the soil. If it is not practicable to sterilise the seed bed by means of fire, formalin can be used, the method being to water the seed bed after it has been made with formalin solution at the rate of one gallon to every square foot of soil. The solution is made up at the rate of 1 gallon of commercial formalin to 50 gallons of water. After the solution has been applied a cover should be put over the bed for two days to prevent the fumes escaping. Covers should then be removed and the beds stirred and allowed to air for at least 10 days before sowing the seed. The land around the bed should be cultivated and kept bare of vegetation so as to destroy any plants or weeds which might harbour insect pests.

The bed should be built up above the surrounding land by jarrah boards on edge, the edges of the boards being several inches above the surface of the finished seed bed, which should not be flat, but have a good slope from back to front so as to get all the drainage possible. The slope should be towards the sun. To simplify weeding and looking after the beds generally, it is strongly recommended not to have the beds wider than 3ft. 100 square yards of seed bed is usually provided for each 5 acres.

After the soil has been worked to a fine tilth and levelled, the seed should be sown on the surface. The rate of seeding will, of course, depend upon the germinating power of the seed. An ounce of good seed will plant 100 square yards of seed bed. A simple way of sowing is to mix the seed with fine sifted wood ash and sow first lengthwise and then crosswise by shaking through a tin perforated with nail holes in the bottom. After sowing the seed the surface of the bed is firmed down with a board and watered thoroughly with a very fine rose watering can and the covers of calico, or some other suitable material then put on. The calico can be tacked to frames which rest on the edge of the timber around the seed beds.

If the seed bed is properly prepared in a warm sheltered position, germination should take from 6 to 12 days, depending on the weather. Seed sown in the open may take six weeks to germinate if weather conditions are unfavourable.

After seeding, it is most important to keep the surface moist, by watering as required, until the plants are up. After plants are showing the third leaf, the surface waterings should be reduced to a minimum and every opportunity should be taken during bright fine sunny days to raise the glass frames or calico coverings so as to harden the seedlings.

Any weeds must be removed as soon as they can be handled, and the plants should be thinned out to approximately one to the square inch.

Eight to ten weeks after germination, the plants should be ready to plant out.

In case of accidents, it is a good plan to grow twice as many plants as it is estimated will be required, and have three sowings at ten-day intervals.

FIELD PREPARATION.

The land should be fallowed in the autumn and kept free from weeds with the cultivator. A second ploughing will be necessary in the spring about a fortnight or three weeks before planting out, and the surface worked to a fine tilth.

FERTILISER.

The fertiliser recommended is—

100 lbs. Sulphate of Ammonia
50 lbs. Nitrate of Soda
600 lbs. Superphosphate
100 lbs. Sulphate of Potash

at the rate of 1,000 lbs. per acre. The fertiliser is applied along an open furrow which is then covered with a plough from each side and levelled off, the plants being set out on top of this covered-in furrow at 20in. intervals, the furrows or drills being spaced 3ft. 6in. apart.

TRANSPLANTING.

When the plants are from three to four inches high, they are large enough to transplant into the field. The seed bed should be well watered before pulling, and care must be taken to avoid breaking the roots or damaging the hearts of the young plants.

Suitable weather should be selected for transplanting into the field, but should it be necessary to plant out when the weather is warm, each plant should be given a little water as it is set, even half a pint will greatly assist in getting an even stand.

It is good practice before pulling the plants out of the seed bed to first spray with an arsenate of lead mixture, half an ounce of powder to one gallon of water. This will protect the plants from cut worms. If this pest is in the field it is also recommended to lay down Paris Green and bran baits made up of bran 30 lbs., molasses 4 lbs., Paris Green 1 lb. The bran and poison powder should be thoroughly mixed in dry form—the molasses should then be mixed with the dry ingredients and water added with constant stirring until the bait is of a crumbly consistency. This bait should not be laid in direct contact with the seedlings.

The plants are handled by the tips of the leaves and should be set deep enough to enable the soil to keep the leaves wrapped around the heart of the plant, the heart of the plant being just level with the surface of the ground.

CULTIVATION.

As soon as the plants have struck, the work of cultivation should commence, first by hand hoeing round the plants without cutting or disturbing the roots, and then cultivating between the rows with a Planet Junior or other single horse cultivator to break and loosen the soil to form a mulch to prevent evaporation of moisture.

It is of considerable importance that the plant be kept growing from the time it is set out in the field, and this can be greatly assisted by continuous cultivation. As the season advances it will not be possible to cultivate as deeply as the early cultivations on account of the danger of injuring the roots.

TOPPING AND SUCKERING.

As soon as the flower buds appear at the top of the plant, they should be cut out. This operation, which is known as topping, will commence about ten weeks after planting out. The average number of leaves left after topping will be ten or twelve, some more and some less, according to whether the plant is showing vigorous growth, or otherwise. A vigorous plant topped too low will produce a coarse leaf with a prominent mid-rib, which is undesirable.

Topping will cause the plants to branch out from where the leaves join the stem. These shoots have to be removed by breaking them sideways with a finger and thumb before they reach three inches in length. The crop will have to be gone through two or three times between topping and harvesting to remove the side shoots or suckers, as they appear. Both topping and suckering are important operations, and can only be neglected or delayed at the sacrifice of quality in the leaf.

To obtain the bright coloured good smoking leaf required by the manufacturer, not only must the right soil, fertilisers and varieties be used and the plants kept growing without a check, but the leaf must be harvested at the right stage of maturity.

INDICATIONS OF MATURITY.

As the leaf matures it loses its smooth appearance and becomes roughened and brittle, increases in thickness or body, and if folded between the finger and thumb will split. The green colour of the young growing leaf changes to a lighter shade and is flecked with yellow. These are all indications of maturity

Harvesting will commence from two to five weeks after topping according to the soil and season.

The bright yellow colour indicating full ripeness will show at the tips, and if the leaf is left on the plant long enough will spread over the surface to the butt end. Before this occurs, however, the first part of the leaf to colour will have darkened and started to decay. The leaf is, therefore, picked somewhat before the stage of full ripeness, and maturity hastened and evened up artificially in the curing barn.

HARVESTING.

The leaves of the tobacco plant do not mature simultaneously but progressively from the bottom upwards, and as it is important for successful curing to have the barn filled with leaf of uniform maturity, the method of harvesting is to strip the leaves off the plant as soon as they are ready.

Four or five pickings will generally be necessary to complete the harvest, and the intervals between pickings will be from 7-14 days according to conditions. Harvesting and curing, therefore, are practically a continuous process from the time the lower leaves mature until the top leaves are finally stripped from the plant.

The average plant at each picking will yield from 2-3 mature leaves or more, which are broken off by hand and carefully handled so as to avoid breaking or bruising them.

A simple method of collecting the leaves is to strip them off into hessian squares or bags cut open, placed at convenient points in the field. These can then be folded over, pinned together at the corners, and carted without delay to the stringing-on shed.

Harvesting should not be carried out immediately after rain or while the leaves are wet with dew.

Each picking must be completed and the leaves placed in the curing barn in one day, and for that reason this operation calls for the employment of additional labour.

STRINGING ON.

The harvested leaf must be protected from the sun; therefore, the work of attaching the leaf to the hang sticks is carried out under cover, which usually consists of a lean-to roof against the curing barn, provided with a bench to which the leaf is carted from the field.

The hang sticks are made of 1in. x 1½in. timber 4ft. 6in. long, so as to enable them to rest on the tier poles which are placed at 4ft. centres in the barn. One method of attaching the leaf is to string it on to alternate sides of the hang stick in bunches of three and four leaves.

A piece of string twice the length of the hang stick being folded double, is attached to the middle of the stick. A bunch of leaves is then held in position alongside the middle of the stick and a single piece (strand) of the string passed round the butts and brought diagonally across to the other side and round the next bunch of leaves similarly held and so on, working backwards and forwards across the stick from the middle towards the operator.

The leaves are tied about 1in. from the butts and the string finally fixed by drawing it into a split in the end of the stick, which is then reversed and the same procedure carried out from the other end.

The method recommended, however, is to attach the leaves by wire. At 8in. intervals pieces of ordinary fencing wire about 18in. long are bent around and stapled to the stick so as to provide points 5in. or 6in. long at right angles to it.

The leaf is placed on a bench with the butts towards the operator, who threads five or six leaves on to each point through the midrib about 1in. from where it is broken off the plant, the leaves being threaded on alternately back

to back and face to face with the thickness of a finger allowed between each. The hang sticks must be held in position during this operation, and notches are provided for the purpose on the edge of the bench and on posts let into the ground 4ft. away. As soon as the leaf is attached, the hang stick is placed in the barn.

THE CURING BARN.

The flue curing process requires varying temperatures and humidity. The curing barn must, therefore, be provided with a heating apparatus and be air-tight. Ventilators both top and bottom are also essential, as the circulation of air is necessary at certain stages.

The width of the building must be a multiple of 4ft., so as to fit in the hang sticks. These rest on tier poles placed through the structure at 4ft. centres apart horizontally and 2ft. vertically, the lowest tier being placed 8ft. above the floor. The length of the building parallel with the tier poles is not so important as the width, but it is usual to build the barn square.

Curing barns have been built of brick, wood, fibrolite, and galvanised iron. However, the cost will be the main consideration in the material used.

The illustrations give details for constructing a standard size barn 16ft. x 16ft. and five tiers high built of fibrolite—the blocks being supplied by James Hardie and Co., Ltd., Rivervale. A barn this size will be required for each five acres.

Larger barns are not recommended as the cure would be less uniform and they would be more difficult to fill in the one day.

Cheaper flues could be made of 20 or 22 gauge iron. A three-foot wide sheet will make an 11in diameter flue, which is connected up in short lengths like a stove pipe. The life of such a flue would, of course, be much shorter than that shown in the illustration, but it would be much cheaper.

The flues require to be given a gradual rise of 2ft. from where they enter the barn from the furnace at floor level to where they go through the wall to connect with the smoke stacks outside. They should not be placed nearer than 18in. to the walls of the building on account of the danger of fire.

Fire bricks are necessary for the furnaces, and it will be noticed that 9in. ordinary brickwork is carried up 4ft. at the furnace end of the barn. This is also necessary on account of the danger of fire. It is recommended that the floor be made of concrete.

The top ventilation can be improved by having the ridging so arranged as to be able to raise it above the tip of the roof so that ventilation is provided the whole width of the building. The vents must, however, fit closely so that the barn is as air-tight as possible when they are closed.

It is estimated that a fibrolite barn would cost from £80 to £90.

A wet and dry bulb thermometer (Psychrometer) will be required in the barn to determine the humidity and temperature. The method of making this is described by Mr. G. E. Marks in his formula for curing cigarette leaf, given later on.

It is often necessary to put moisture into the barn to get the humidity required at the commencement of curing. Steam generated from a 5-gallon petrol drum and conveyed from it to the barn through a piece of hose will be found most useful in this connection.

CURING.

This process is the most important operation in the production of good leaf for market and requires judgment, knowledge and care, in the absence of which experience may be very dearly bought.

As the trade requires a bright coloured flue cured leaf, it is necessary for growers to supply this, otherwise the growing of the crop, except as an experiment, should be left alone.

Failure is bound to result if conditions are unsuitable. On the other hand, it is a simple matter to ruin the leaf in the curing barn even if a first class leaf has been harvested. It is not possible to lay down a hard and fast formula for curing all tobacco, and the curer must use his judgment in making modifications as the necessity arises.

There are three stages in the process, known as (1) Yellowing the leaf, (2) Fixing the colour, and (3) Drying out the midribs and stems.

Yellowing takes place while the leaf is still living and requires from 24-36 hours. At temperatures above 120deg. F. the leaf is quickly killed, so this point must not be passed during the first stage.

As soon as the barn is filled, the psychrometer is hung in the centre among the leaves of the bottom tier; vents and door closed and fires lit. The curing is started at 80deg. F. or 90deg. F., and the first stage should be completed at 110deg. F. or 120deg. F.

The leaf must not be dried too quickly at the beginning, but as it colours up the humidity of the barn must be reduced by slowly raising the temperature and gradually increasing the ventilation.

The next stage, "Fixing the colour," is the critical part of the cure, the object being to remove the moisture as fast as it is given off by the leaf. If the leaf contains very much moisture, when the yellowing has been completed, patches of red or brown will appear on the surface of the leaf. This trouble, known as sponging, is caused by insufficient ventilation towards the end of yellowing. More ventilation may prove beneficial, but it is often too late to correct the trouble at this stage.

If the heat is increased too rapidly while the leaf is full of sap, scorching will result. The temperature should be gradually increased throughout this stage of the curing until 130deg. to 135deg. F. and kept at from 130deg. to 140deg. F. until the web of the leaf is completely dried out, which will be from 10-18 hours after the completion of the yellowing process.

The critical stage is now past and the last stage is simply a matter of drying out the midribs and stems. The ventilators are nearly closed and the temperature raised 5deg. per hour to 170deg. F. and held until the stems are completely dried out.

FORMULA FOR CIGARETTE LEAF.

Gradually raise temperature to 95deg. in six (6) hours, remain at this point for three (3) hours, then cease firing, and allow temperature to drop back to about 90deg. and remain at this temperature until the leaf has attained a light pea green colour or is about half yellow. This usually takes about 20 or 30 hours from the start point, and for the whole of this 20 to 30 hours the atmosphere should be kept as nearly saturated with water vapour as possible. This can be done by applying water freely to the floor and pipes. A psychrometer is necessary to ascertain the degree of humidity required.

When the leaf has attained the half yellow colour, advance the temperature 2½deg. an hour to 100deg., then open ventilators in roof about three inches, also slightly open bottom vents and continue to raise the heat to 110deg. in four (4) hours. When this degree is reached open all of the ventilators wide both in roof and at floor level and let them remain thus until the web of the leaf is dry, remain at 110deg. for eight hours, then at this stage the tips of the leaf should be commencing to curl up bright; if not, remain at 110deg. until this takes place. Then carry the heat up to 115deg. in two hours, remain there for eight hours, then advance to 120deg. in two hours, stand at this temperature until the web of the leaf is almost dry, then continue to 125deg., where the drying of the web of the leaf is completed. Now half close the vents and raise the heat at the rate of 5deg. per hour until 170deg. is reached. The heat is often taken higher, 180deg. if required, to dry stems which should be quite brittle enough to snap when bent. Close vents for last few hours of drying.

The main points to be observed in the curing process are:—

Moist atmosphere during the yellowing. Plenty of ventilation after 110deg. is reached in the drying. There should be no sweating allowed at this stage, as it causes sponging. Reddening is caused by too severe heat, and is suppressed by reducing temperature 10deg., then gradually raising about 2deg. an hour until the former temperature is reached, then proceed as specified in formula.

AVOID THE FOLLOWING POINTS.

Do not harvest tobacco directly after a rainy spell; it is advisable to wait at least a couple of days if possible, to allow the replenishing of gum on the leaves and also the reduction of some of the surplus sap accumulated.

HOW TO MAKE A PSYCHROMETER.

Take two thermometers and fix them side by side on a piece of board. To the bulb of one of these fasten a strip of thin muslin, one thickness tight around the bulb and secure to same at top and bottom by tying with thread. Cut this wick off about three inches below the bulb, wet the whole and allow about one inch to penetrate and remain in a cup of clean water. The water from the cup is drawn upwards through the wick to the bulb, thus this bulb is being kept constantly moist, while that of the other thermometer is dry. The water on the surface of this wet bulb will evaporate into the air about it more or less rapidly according to the dryness of the atmosphere surrounding it. The more moisture the air contains, and less rapid will be the evaporation and *vice versa*. When the two thermometers register alike the atmosphere is said to be saturated and no evaporation takes place. It is desired to keep as near saturation as possible during the yellowing process, but a difference of 3-4 degrees is permissible. It is important that the thermometer or psychrometer should be hung among the tobacco where a true registration of heat and moisture can be recorded; proper degrees of heat, light and dryness of atmosphere are the fundamental principles essential in drying good tobacco.

BULKING AND HANDLING.

After the stems are thoroughly dried out as mentioned above, all doors and ventilators should be opened wide to allow the tobacco and barn to cool down. The flues may be covered with wet bags and the still warm floor thoroughly wetted, the aim being to make the atmosphere moist. In a saturated atmosphere tobacco

will come into order in a couple of hours, on an average, and it should then be taken down and bulked.

Too much moisture in the leaf tends to darken it, and also makes favourable conditions for mould; it is essential, therefore, that the leaf should not remain in a moist atmosphere too long.

It should be bulked just before it is soft with a slight crackling in the lateral veins when squeezed in the hand; at the same time the midribs should be brittle enough to break when bent about one-half their length.

Tobacco should not be bulked on or nearer than one foot of the ground, as it absorbs moisture readily and will soon go mouldy. It is a good plan to make a bench of boards with air space underneath.

To bulk tobacco it is usual to lay two rows of leaf with butts outwards, allowing the points of the leaves to lap about one-third of their length. The bulk may be made to any convenient length and height.

After each lot is bulked it should be covered thoroughly with rugs or bags and weighed down tight to prevent drying; it should also be examined every few days to note if heat generates, and if the temperature rises above 80deg. F., the whole should be turned.

After the leaf has been in bulk for six weeks, it is ready for grading and packing for market. The leaf is graded according to colour, texture, and size. the colour grades being—lemon, orange, bright mahogany, mahogany, and dark.

If the leaf from each cure has been kept separate in the bulk, the texture will be fairly uniform in each lot and the grading will chiefly be a matter of colour and size. The graded leaves are tied into bundles or "hands" by wrapping a leaf around the butt ends, the tie being made by pulling the end of the tie leaf through the "hand," a sufficient number of leaves being put into each bundle to make the butt of the "hand" approximately one inch in diameter.

The leaf is then baled under pressure, the weight of a bale being from 150-200 lbs.

Acknowledgments:

Garner, W. A., "Tobacco Curing," Farmers' Bulletin, No. 523. U.S.A.

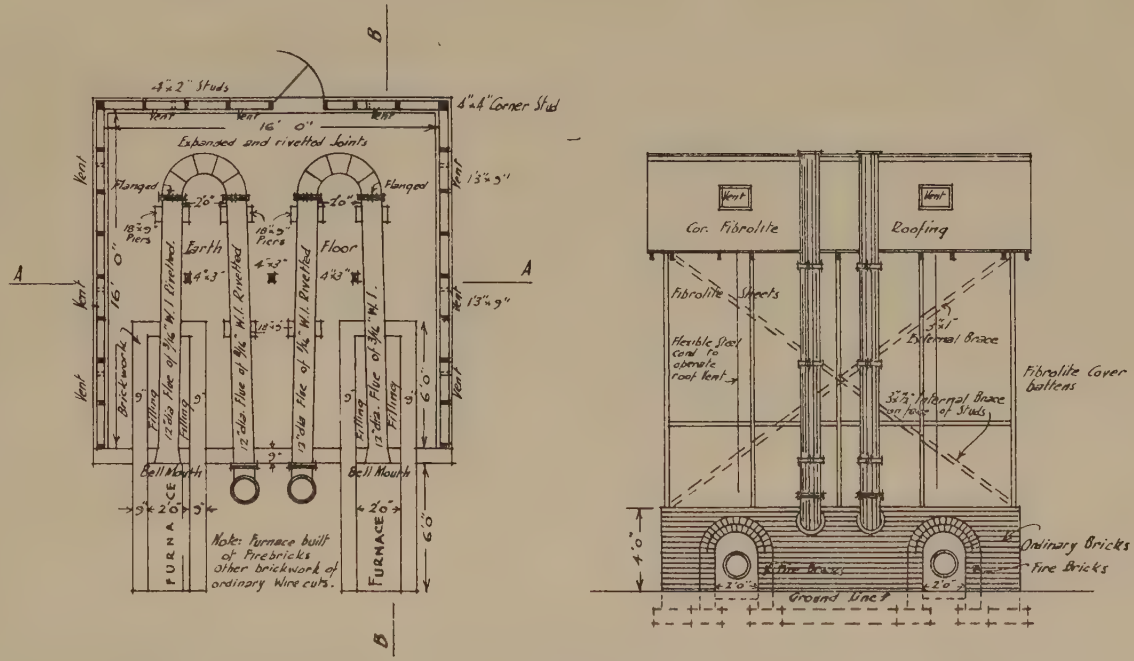
Killebrew, J. B., and H. Myrick, "Tobacco Leaf."

Marks, G. E., "Production and Flue-curing of Tobacco." Bulletin 53, Victorian Dept. of Agric.

Smith, Temple, A. J., "Tobacco Culture." Bulletin 53, Victorian Dept. of Agric.

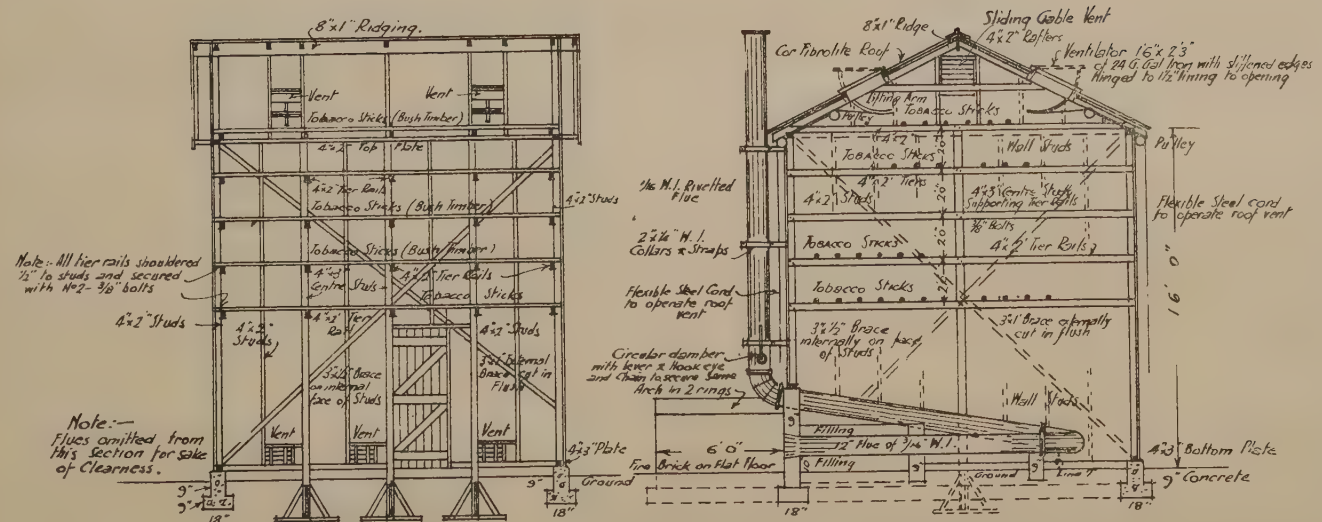
Note.—As tobacco is an excisable commodity, it is necessary for intending growers to keep certain prescribed records, and to be registered as producers. Application must be made to the Collector of Customs, Perth, from whom the necessary forms may be obtained. No fees are payable in this connection but, unless this regulation is complied with, growers are liable to a penalty of £20.

FIBROLITE - TOBACCO - CURING - BARN



GROUND PLAN. Scale:- One Inch = 8 Feet. SIDE ELEVATION.

FIBROLITE · TOBACCO · CURING · BARN



SECTION - A-A. Scale:- One Inch = 8 Feet SECTION - B-B

BRAXY-LIKE DISEASE OF SHEEP IN WESTERN AUSTRALIA.

By H. W. Bennetts, M.V.Sc.

The following report deals with co-operative investigations which are being carried out by the Western Australian Department of Agriculture and the Council for Scientific and Industrial Research.

Braxy-like disease itself is a trouble which mainly occurs in Western Australia, but the causal organism is not confined to this State. In consequence all sheep owners, and particularly those who graze their flocks on rich pastures for long periods, may find much of interest to them in this report.

A brief note dealing with the progress of the investigation into this disease was given in a previous issue of the C.S.I.R. Journal (Vol. 2, pp. 109, 246, 1929). Since that time, however, the cause of the disease has been definitely established and some methods of control introduced.

The Western Australian braxy-like disease is an acute infectious disease of sheep. It is characterised by a fatal termination, frequently without premonitory symptoms. Fat animals chiefly are attacked, and putrefaction after death is rapid. There are, however, no very characteristic post-mortem changes in fresh carcases, such changes as are seen being simply the evidences of toxaemia or general poisoning. The most characteristic feature is the presence in the small bowel contents of very large numbers of a micro-organism closely allied to the *Bacillus Welchii*, and for which the definite and specific name *Bacillus oritoxicus* is herewith adopted. The above characteristics of the disease have led us to adopt the descriptive scientific name "infectious entero-toxaemia." The disease has a definite seasonal occurrence (April to October), and is confined to cultivated, and particularly to well-improved, areas. It does not occur on "bush" lands, and the incidence may be checked by transferring affected flocks to uncultivated pastures.

1.—HISTORY.

The disease evidently appeared first in the Beverley-York district about the year 1915, its appearance being said to have been preceded by a period of increased agricultural activity in this area. Although, as far as can be ascertained, only one or two properties were affected in 1915, the disease soon spread over a wide area, and began to assume serious proportions.

No systematic investigation was made until 1918, when the services of Professor Dakin of the University of Western Australia were made available. He described the symptoms and post mortem appearances, and finally gave the opinion that the disease was probably of bacterial origin. Recognising the superficial resemblance of the disease to braxy, and to the braxy-like diseases of the Eastern States, he designated the Western Australian condition as a "braxy-like disease."

It has been shown by the writer that the local disease is quite distinct from true braxy (of Europe) and from black disease of the Eastern States. Bull* has described a disease affecting sheep in South Australia, which is most probably identical with the Western Australian disease.

* Bull, L. B.—Aust. Assoc. Adv. Sci. Report 17 : 715, 1924.

In 1902, and subsequently,* and again in 1910,† Gilruth described a somewhat similar braxy type of disease in the South Island of New Zealand affecting hoggets fattened on turnips, and recently expressed the opinion that it is most probably the same as that occurring in this State.

In the light of recent knowledge, Dakin's name "braxy-like disease" is to be deplored, because of the confusion its use may occasion. Nevertheless, in view of its universal acceptance in this State the term is retained for the Western Australian condition and is here used in that restricted sense.

In 1925, the writer was appointed the first Veterinary Pathologist to the Department of Agriculture of Western Australia, and commenced an investigation of the disease. In 1928 he was seconded to the Council for Scientific and Industrial Research, and since then has devoted practically the whole of his attention to this problem. The Council has provided increased facilities and assistance for the investigation.

2.—DISTRIBUTION AND ECONOMIC IMPORTANCE.

Orginally confined within a small radius, the disease has spread over a large area of country extending from Three Springs in the north to Gnowangerup, Tambellup, and Bridgetown in the south; a distance of roughly 380 miles. It has also spread in an easterly and westerly direction, following the lines of settlement, and has been reported along the Eastern Goldfields line as far as Merredin. The heaviest losses, however, have been experienced in the Great Southern district.

The disease, not being a notifiable one, it is impossible to determine the economic loss even approximately, but at a conservative estimate, it must run into hundreds of thousands of pounds sterling annually.

3.—INCIDENCE.

The mortality varies considerably from year to year as regards both districts and individual properties, the variation being from less than 1.0 per cent. to 29 per cent. of the flock.

The disease has a definite seasonal occurrence, and follows the appearance of green feed after the first rains. With early (February-March) rains it may appear in April. Deaths occur spasmodically until late October, when the feed has normally dried up. It is definitely associated with green feed, although small losses due to braxy-like disease do sometimes occur when sheep are feeding on ripened peas during the summer months.

The annual variation in incidence would appear to depend on two main factors, namely, cultivation and naturally acquired immunity.

(i) *Cultivation.*—The occurrence is definitely related to cultivation and pasture improvement. In the absence of cultivation there is practically no permanent pasture in the affected areas apart from natural herbage with a low-carrying capacity. During the winter months sheep are largely depastured on green crops (oats, rape, wheat, etc.) or on weeds which grow in cultivated paddocks. Paddocks left uncultivated and untreated with phosphates carry little forage. Improved pastures, consisting mainly of clovers, have been established (in small areas) with the assistance of superphosphate top dressing. The carrying capacity of cultivated

* Gilruth, J. A.—New Zealand Department of Agriculture, Annual Reports.
† Gilruth, J. A.—Aust. Assoc. Adv. Sci. Report 13: 567, 1910.

and improved country is from half a sheep to two sheep per acre. The disease has become an almost inevitable sequel to cultivation and pasture improvement in certain districts, and frequently the incidence seems to be directly related to the degree of improvement. It is constantly appearing in new localities following the opening up and improvement of country.

(ii) *Naturally acquired flock immunity.*—Records kept over a number of years show that on properties in districts where the disease has been known for a number of years, the death rate due to braxy-like disease almost invariably shows a steady decline. Uusually, within about five or six years, the mortality rate in flocks which are bred on these properties ultimately becomes less than one per cent. or may disappear entirely. The heaviest losses are generally experienced in flocks which are imported into affected districts from localities where the disease is unknown, or in flocks in districts where it has just recently made its appearance.

Sheepowners who have experienced a decrease of mortality are always ready to admit that this is not due to any change in conditions or to any attempted methods of control. Apart from the beneficial effect of changing to unimproved ("scrub") country where available, they have found no effective method of arresting the course of the disease except perhaps starvation, which they do not favour. The only satisfactory explanation of the gradual decrease is that flocks gradually acquire a natural immunity.

When the disease first makes its appearance in a flock, the heaviest losses occur in the grown sheep of all ages; in subsequent years the percentage of total mortality experienced becomes progressively greater among lambs 2-4 months old, and smaller in the older animals. It appears that most of these older animals which survive have been affected with the disease to some degree, and acquired an immunity. This immunity is apparently strengthened by the continuous exposure to infection, and is ultimately handed on to the lambs, probably by means of immune bodies in the milk. Mason Dalling and Gordon* have shown that ewes immunised with a very closely allied organism the lamb dysentery bacillus, do actually eliminate, in the cholostrum or first milk, immune bodies which protect the sucking lamb from lamb dysentery.

(iii) *Other factors.*—Of other factors influencing the incidence, the condition of the sheep is the most important. Chiefly sheep in good condition are affected, and particularly rapidly fattening animals. Sheep, of any age from two months onward, and rams, ewes, and wethers all appear to be equally susceptible. All breeds are evidently susceptible, the disease having been encountered in Merinos, Border Leicesters, Romneys, Comebacks, and various crossbreeds.

4.—SYMPTOMS.

The period between the onset of recognisable symptoms and death is very short, the great majority of sheep being merely found dead, usually near the camp and in the morning. Consequently great difficulty has been experienced in obtaining suitable subjects for clinical and pathological examination. Sheep occasionally show symptoms after driving, as in changing pasture, yarding, etc., and dead sheep are very often found on the morning following a change over to fresh pasture.

Two types of symptoms have been noted:—

(i) *Comatose, or quiet, type.*—The affected animal at first appears restless and excited. It moves about with nose to the ground, chewing dirt, sticks etc. The gait becomes staggering and soon the sheep lies down, usually on its side with its

* Jour. Path. and Bact. 33 : 783, 1930.

head turned to the left flank. It rapidly becomes unconscious, and the breathing is hurried and irregular. Death is quiet, generally within three to four hours after the first signs of illness, but in rare cases it may be delayed for about 24 hours.

(ii) *Convulsive type.*—An animal, apparently only slightly dull, is suddenly seized with convulsions. It lies stretched out on one side with head turned back and continuously exhibits more or less violent "galloping" movements associated with twitching of muscles, etc. Death usually occurs within two to four hours.

5.—PATHOLOGY.

During the course of the investigation it has been possible to make careful post mortem examinations of 30 sheep dead of typical braxy-like disease, the animals being either killed when symptoms definitely indicated the nature of the disease, or being allowed to die. In all these cases the examination was made immediately after death. In no case has there been any indication of the characteristic abnormalities seen in true braxy or in black disease.

The changes seen in fresh carcases are very slight:—The mesentery and bowel walls are injected with blood, the liver is somewhat soft and frequently somewhat congested; the kidneys are congested, and the heart usually shows pronounced subendocardial haemorrhages. Internal parasites are rare or occur only in small numbers. Fluke is unknown in Western Australia. Microscopic examination of organs, liver and kidney particularly, shows evidence of changes usually associated with the circulation of a toxin or poison. All the available facts pointed to the disease being most probably of bacterial origin. In the fresh cases examined, however, there was no evidence of bacterial invasion of any of the body tissues.

6.—BACTERIOLOGY.

(i) *General.*—In ten cases attempts were made to cultivate bacteria from various situations, namely, the liver, bile, spleen, kidneys, heart, blood, etc. Post mortem examinations were made with careful aseptic precautions, and tubes of various types of culture media were sown with the above materials. In only two cases was any germ isolated which could be regarded as a possible cause, and that was a bacterium, subsequently found to be the causal organism—*Bacillus ovitoxicus.*

B. ovitoxicus is a microscopic, rod-like organism or bacillus, which is able to develop spores and thus persist for long periods in soil, etc. The bacillus belongs to the anaerobic group which grows only in the absence of free oxygen. It can be readily cultivated artificially. It was at first thought to be *B. Welchii*, an organism which was one of the main causes of gas gangrene in soldiers during the war, but by means of a highly technical test it has been possible to demonstrate that it is really an entirely new organism.

It appeared that the disease was not due to direct invasion of the blood or body tissues by any bacterium, although there was already some evidence that this *B. Welchii* type of organism might be operating from the bowel. It was therefore decided to investigate the bacterial flora of the bowel contents, particularly as Bull (loc. cit.) had demonstrated the proliferation of *B. Welchii* in the bowel contents of sheep affected with a similar disease in South Australia.

(ii) *Investigations of stomach and bowel contents.*—Material from different levels in the gastro-intestinal tract was microscopically examined. As a result it was shown that an outstanding and constant feature in 18 cases of braxy-like disease was the presence of large numbers of *B. ovitoxicus* in the contents of the

small intestine. In the bowels of normal sheep and of sheep dying from diseases definitely other than braxy-like disease, the presence of this bacillus could not be demonstrated microscopically..

Associated with the prolific growth of this specific germ in the bowel contents is a potent toxin. If small bowel contents (fresh or preserved with 0.5 per cent. chloroform for 24-48 hours) of normal sheep are passed through a bacterial filter, which removes all germs, comparatively large doses can be inoculated into mice or guinea pigs without any ill effects. On the contrary, similar germ-free filtrates of bowel contents of sheep dying from braxy-like disease are very toxic for these animals, and even for sheep. Amounts as low as 0.002 c.c. have been shown on inoculation to be fatal for mice and 0.45 c.c. for guinea pigs.

That this toxicity is due to the elaboration of a toxin by the rapidly multiplying *B. ovitoxicus* is shown by the fact that experimental animals can invariably be protected by the use of the antitoxin of this bacillus. Mice and guinea pigs inoculated with suitable amounts of mixtures of bowel filtrate, from cases of braxy-like disease, and with *B. ovitoxicus* antitoxin remain normal, whereas similar animals inoculated with the same (or smaller) amount of bowel filtrate without admixture of antitoxin invariably succumb. The properties of the bowel filtrates from affected sheep have also been shown to be identical with the toxin produced by *B. ovitoxicus* in artificial culture medium (horse-muscle broth).

We arrive at the point then that a prolific growth in the small bowel contents of the *B. ovitoxicus*, with the production of a potent toxin by it is a constant feature of braxy-like disease, and of no other disease of sheep investigated.

7.—EXPERIMENTAL PRODUCTION OF THE DISEASE.

(i) *Inoculation experiments.*—Guinea pigs, and susceptible sheep (bred outside the area where braxy-like disease is known to exist) were inoculated with blood from affected sheep. One guinea pig inoculated with 10 c.c. of blood died from a *B. ovitoxicus* infection, but apart from this, all experiments were attended with negative results.

One experimental sheep inoculated with germ-free filtrate of the bowel contents of an affected sheep, and two sheep inoculated with culture toxin of the *B. ovitoxicus* died within about 24 hours from what closely resembled naturally occurring braxy-like disease both in symptoms and pathology.

(ii) *Drenching experiments.*—All evidence indicated that the natural method of infection was by the mouth, field observations having proved the important bearing of certain dietetic conditions on the incidence of the disease. There was never any evidence of the introduction of infection through wounds, and nothing suggested the operation of any insect transmitter.

Attempts to produce the disease in susceptible experimental sheep, by drenching them with stomach and bowel contents from affected sheep and with cultures of the bacillus, were all attended with negative results. Sheep were stall fed on types of diet which, it had been noted, tended to favour the appearance of the disease in the field, and over long periods were given doses of cultures daily. Sheep running on pastures, which were known to be "dangerous" were drenched in the field with cultures. Always the results were negative.

It was postulated that the reason for the negative results obtained might be due to the fact that the acid in the stomach destroyed the bulk of the bacteria before the more favourable small bowel situation was reached. Accordingly, sheep

were treated so as to diminish the acid content of the stomach and given drenches of culture. Still negative results were obtained.

Recently however, it has been found possible to bring about the desired result. Williams* had shown that when the small bowel of the human subject becomes obstructed, there is frequently a prolific growth of *B. Welchii* in its contents followed by the development of a *B. Welchii* toxaemia, and it appeared that somewhat similar conditions might favour the growth of the closely allied *B. ovitoxicus* in sheep bowel contents.

By the use of belladonna, which generally depresses the secretion of stomach acid, and opium (at the suggestion of Dr. Gilruth) which slows the movement of the bowel, followed by cultures of *B. ovitoxicus*, we have successfully reproduced braxy-like disease in four experimental sheep. The drugs have been given by the mouth in milk (which apparently acts as a vehicle to carry them direct to the fourth stomach instead of only to the rumen, Wester†), and were followed by cultures similarly administered. The experimental disease resulting therefrom resembles the naturally occurring one in all particulars, symptoms, pathology, bacteriology, etc. Symptoms have occurred as early as nine hours after the commencement of the experiment. Some sheep, however, appear to have a natural resistance to the disease, and cannot be infected by this experimental method (two out of six sheep have proved resistant).

8.—THE CAUSE OF THE DISEASE.

As a result of these investigations it is claimed that the braxy-like disease of sheep in Western Australia is due to the proliferation of *B. ovitoxicus* in the small intestine contents of affected animals with the production of a highly potent toxin and its absorption into the blood stream.

(i) *Predisposing Factors.*—

As previously pointed out, there are certain factors which favour the appearance of the disease:—

(a) *Cultivation and pasture improvement.*—It is well known that the anaerobic group of bacteria, primarily soil germs, to which *B. ovitoxicus* belongs, much prefer cultivated land, and are more numerous there than in uncultivated soils. It has been claimed that richness of soils in soluble lime and phosphate increases the virulence or disease-producing power of this group of germs. If so, it would explain to some extent the association of the disease with the use of superphosphate.

(b) *Bowel sluggishness.*—Both experimental and field observations indicated that this is an important predisposing factor. The main stimulants to bowel action in ruminants are fibre and exercise. Braxy-like disease is almost always associated with the minimising of these factors, the animals affected being fat sheep in sluggish condition and taking little exercise on abundant luscious green pasture rich in moisture and poor in fibre content. Losses have been found to occur also when sheep are feeding on ripe peas (pods and seeds) in summer and subsisting almost entirely on the dry seeds picked up from the soil—a concentrated ration without much fibre.

Certain owners claim that compulsory daily exercise reduces the mortality. There is also evidence that a supplement of dry feed (rich in fibre) has a bene-

* Brit. Jour. Surgery, 14 : 295, 1926.
† Vet. Jour. 86: 401, 1930.

ficial effect in reducing the incidence. The preventive effect of "scrub" country is probably due in part to its high fibre content and the necessity for greater muscular exercise.

(c) *Injury to the small bowel.*—As might be expected, this exerts a favouring influence on the growth of the bacillus, but the action of this factor has only rarely been demonstrated. Usually the lining of the small bowel shows no injury except for changes (congestion and haemorrhage) occasioned by the action of the toxin produced. Occasionally, however, the injury inflicted by the barbed hairs of the pappus attached to the seeds of *Inula graveolens* (stinkwort) is followed by the proliferation of *B. ovitoxicus* in the bowel contents, with the result that a condition resembling braxy-like disease develops. In such cases which have come under notice, the lining of the bowels (large and small) has presented a more or less dense feltwork of stinkwort hairs penetrating more or less deeply into the bowel wall. Judging from information supplied by officers of the Stock Department in South Australia, in which State deaths in sheep are often ascribed by stockowners to poisoning by stinkwort, it seems probable that the so-called stinkwort poisoning as seen in that State is due to braxy-like disease of the Western Australian type. The fact that feeding tests carried out in South Australia have failed to demonstrate any toxicity in the plant supports this opinion.

(d) *Biochemical factors.*—The hypothesis of a special biochemical condition of the bowel favouring the growth of the bacillus does not appear to be tenable, because the disease occurs on a fairly wide range of pastures with different chemical compositions; the germ can be cultivated in the small bowel contents of animals fed on quite different classes of feed; and the disease may be experimentally produced in sheep feeding on dry fodder (in which it does not naturally occur), provided that a sluggish condition of the bowel is produced.

(e) *Close grazing.*—Outbreaks in sheep feeding close to the ground and apparently ingesting a large amount of heavily contaminated soil have been investigated. In these cases, even sheep in store condition are affected, and then the important factor appears to be a massive infection with the *B. ovitoxicus* from ingestion of soil.

(ii) *General Conclusions*—

From our observations and experiments, the sequence of events in an outbreak of Western Australian braxy-like disease on a property is as follows:—

The soil has been improved by cultivation and the application of phosphatic fertilisers, resulting in increased carrying capacity through the growth of more nutritious feed. *B. ovitoxicus* is introduced to the property by animals carrying it as an innocuous inhabitant of the large bowel. The improved soil has, partly through the fertilisers direct, and partly through the sheep's droppings, become more favourable than virgin soil for the multiplication therein of the bacillus. Numbers of bacilli may be ingested from time to time by grazing sheep. When feed is comparatively scarce or non-succulent, no harm results: the organisms are either destroyed by the stomach secretions or pass rapidly through the small intestine to the large, where they increase but slowly, if at all, and with no ill effects. When, however, the feed is rich and succulent with little fibre or cellulose and the sheep is putting on condition fairly rapidly, taking the minimum of exercise, the normal movements of the small intestine diminish materially, consequently the bacillus on reaching that bowel multiplies enormously, liberating its deadly toxin or poison, which being rapidly absorbed into the blood stream produces the symptoms followed by early death so characteristic of the disease.

9.—IMMUNITY-VACCINATION.

(i) *Naturally acquired immunity.*—The evidence for the assumption of a naturally acquired flock immunity has already been discussed. It is hoped in the near future to give a direct proof of the claims in this regard.

(ii) *Artificial immunity—vaccination.*—The evidence of a naturally developed immunity and the successful results which have attended the use of "anaculture" of a closely related organism (the lamb dysentery bacillus), lent encouragement to an investigation into the value of a similar type of vaccine prepared from *B. ovitoxicus.*

(a) *Preparation of vaccine.*—The organism is grown for 24 hours at body temperature in horse-muscle broth, containing 0.1 per cent. glucose and fresh pigeon muscle. The toxin content is then determined by inoculating mice with small amounts of germ-free filtrate of the culture. To the bulk, 0.5 per cent. formalin solution is added. The formalised culture is then bottled, tightly stoppered, and incubated at body temperature for 10-15 days. The formalin destroys all the bacteria and converts the toxin into anatoxin, a substance which is no longer poisonous, but is strongly antigenic, or effective as a producer of immunity. The vaccine or anaculture is incubated until the process is complete, the harmlessness of the product being tested by inoculating guinea pigs at regular intervals until they tolerate a 10 c.c. dose without any ill effect. The completed product thus contains dead bacteria and anatoxin. Before issue for use in the field, the vaccine is further tested for innocuity by inoculating sheep subcutaneously with 20-30 c.c.

(b) *Laboratory tests with anaculture.*—The vaccine has been tested on guinea pigs in the laboratory, but results have been disappointing with these animals, very little protection being conferred against subsequent infection with *B. ovitoxicus.*

Sheep were inoculated with 5 c.c. of anaculture, and three weeks later with a further 10 c.c. In a month's time they were then tested in two ways. Four vaccinated sheep resisted the inoculation of amounts of toxin equal to or greater than the quantity which killed each of two unvaccinated control sheep. Four other sheep vaccinated in the same way were tested after the same period of time by drenching with belladonna-opium and cultures of the bacillus. Two unvaccinated control sheep were also dosed similarly. These four vaccinated sheep showed no departure from normal: one control died of typical braxy-like disease within 14 hours of the commencement of the experiment, and the other sheep showed definite symptoms of the disease but recovered.

These results, though not conclusive, are significant.

(c) *Field tests with anaculture.*—In 1930, some 3,000 sheep were inoculated on various properties where the disease had been present in previous years. In every instance, only half of the various mobs were inoculated, and branded, the remaining uninoculated half being run with the inoculated sheep under absolutely identical conditions.

Unfortunately, during last season, the disease only made its appearance on one property where the experiment was being carried out. On this particular place, 923 sheep had been inoculated with vaccine. Only two of these died from braxy-like disease (0.2 per cent.), whereas in the same number of uninoculated animals depastured with them the total loss from the disease was 42 sheep (4.6

per cent.), or twenty times greater. This result is very encouraging, but it is of course realised that further and more extensive tests are necessary before the value of vaccination with anaculture is established. Unfortunately, the incidence of the disease varies so much from year to year that one cannot predict where it may appear during any particular season, consequently large numbers of sheep on numerous properties must be inoculated in order that definite results may be obtained.

Some 10,000 sheep are being inoculated with anaculture at the present time, but the results of this experiment will not be available until a later date.

10.—METHODS OF CONTROL.

As a result of the experimental work already detailed, the following methods of control may be indicated:—

(i) *Preventive inoculation with vaccine.*—The promising results secured by this means have been mentioned. It is hoped that the results of the exhaustive tests which are being carried out in the field this season will definitely demonstrate its value.

(ii) *Feeding of fibre.*—The preventive effect of "scrub country" has been effectively demonstrated. In our opinion, the effects noted are probably due to the high fibre content of the scrub feed as a stimulant to bowel action, thus correcting the stasis which permits the multiplication of *B. ovitoxicus* in the contents of the small intestine. The use of "scrub country" is, however, only of limited value, because the carrying capacity of such land is small, and moreover in the closely settled areas there is very little uncultivated country available for this purpose.

The use of other roughage thus appears to be indicated. Field evidence suggests that supplementary feeding with chaff in automatic feeders is beneficial. Dakin first recommended this practice in 1919, but it was not adopted to any great extent. The disease affecting sheep in New Zealand, which in Dr. Gilruth's opinion is probably identical with the Western Australian braxy-like disease, was checked when sheep had a run-off from turnips (on which the disease mostly occurred) to natural roughage, or were simply provided with straw.

It is suggested that the feeding of chaff, or preferably hay, as often as practicable, say twice a week, or even giving continuous access to straw, would lessen the percentage of mortality. It might, of course, be necessary to yard sheep in order to induce them to eat this dry feed. On one property, the writer has seen sheep eating chaff in preference to the wet green feed in the early morning, and the owner claimed that losses were prevented by this means. In this connection it is interesting to note that several reliable sheep men have found that yarding sheep each night and keeping them in until the pastures have somewhat dried off prevents the occurrence of the disease.

(iii) *Exercise.*—From evidence given in the foregoing, the exercise of sheep as far as practicable is recommended. It is claimed by several sheep farmers that "dogging" sheep around the paddock each morning will prevent the appearance of the disease. One rather hesitates to recommend this procedure, but it provides some practical evidence of the value of exercise as a prophylactic measure. Compulsory exercise should begin before the disease appears, or right at the commencement of the outbreak, otherwise sheep which have the disease in a mild form and might normally recover, may die as a result of this "shaking up."

(iv) *Avoidance of close grazing.*—Although it is recognised that the best nutritional results are obtained from pasture which is kept close cropped, it may be well to ignore this fact under certain circumstances. Observation has shown that close grazing (with some ingestion of soil by the sheep) is favourable to the occurrence of the disease, particularly where many sheep have died therefrom and have been allowed to rot unburied, resulting in a heavy contamination of soil with the bacillus.

(v) *Disposal of carcases.—B. ovitoxicus* rapidly multiplies throughout the carcases of sheep dead of braxy-like disease, and heavy contamination of the soil may result. All such carcases should therefore be destroyed before putrefaction is advanced. It has been shown that normal sheep may carry the organism in their bowels, and it is quite probable that animals other than sheep may also be carriers. Therefore the carcases of all animals dying from any cause should be destroyed. Carcases are best destroyed by fire: if this is impracticable, they should be buried deeply in an area set aside for this purpose.

(vi) *Prophylactic licks.*—The use of licks containing medicinal substances which will promote small bowel movement is indicated. It is intended to investigate this proposal.

(vii) *Naturally acquired immunity.*—It has not been definitely proved that sheep bred on affected properties eventually develop a naturally acquired immunity to the disease, but there is very strong evidence that such is the case. It appears expedient therefore for sheep-owners in affected districts to avoid, as far as possible, the introduction of sheep from districts where the disease does not occur. It should be the aim to breed from the flock already on the property.

If the vaccine proves effective, new purchases (rams, etc.) should receive preventative inoculations prior to or at least soon after their introduction to affected properties.

HANDLING WHEAT IN BULK.

THE REAL ISSUE—WILL IT REDUCE COSTS?

GEO. L. SUTTON, Director of Agriculture.

Foreword by Hon. J. Lindsay, M.L.A., Minister for Works.

The following article, prepared by the Director of Agriculture as a member of the Bulk Handling of Wheat Committee, was submitted to the Hon. Minister for Works, Hon. J. Lindsay, M.L.A., who, before making it available for publication, made the following comments:—

"The question of bulk handling of wheat is exercising the minds, not only of the wheat growers of Western Australia, but of those of each of the other exporting States of Australia.

The subject to-day is of more importance than it has been in the past because of the very urgent necessity of finding means of reducing the cost of production under the prevailing low prices.

The information contained in this statement is an important contribution on the subject, and Mr. Sutton is to be commended on its compilation. I hope that it will be studied carefully by all persons concerned, from the point of view of reducing production costs, and not from that of purely sectional interest. Such a reduction, whilst benefiting the wheat growers, would also result in a decided advantage to the people of Australia generally."

As is fairly well known to the older generation of wheat growers, I have been an active protagonist for the "bulk handling" of wheat both before, and since, arriving in this State. My reason for this attitude was that, as the result of a close study of the question, I had arrived at the conclusion that the adoption of "bulk," as compared with bag handling methods, meant a saving of at least 3d. per bushel to the producer.

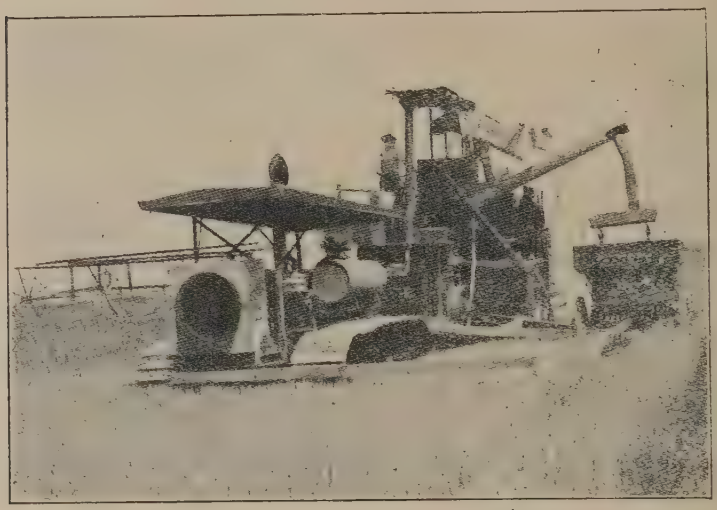
My ambitions in this direction were almost realised during the War period, for, owing to the great losses occurring with bagged wheat during that period, consideration was given to a Commonwealth emergency scheme for storing wheat in bulk in order to avoid the losses referred to. Fortunately the War ended, and, except in New South Wales, the scheme was not proceeded with. As far as bulk handling was concerned this was unfortunate, for had the emergency bulk storage scheme been established it would have inevitably been the forerunner of the general adoption of an Australian scheme for handling wheat in bulk.

Since the War I have ceased to advocate "bulk handling," as I believed the costs of construction and other factors rendered the time inopportune for its consideration. I also believed that it would continue to be inopportune until some unusual and outstanding state of affairs, such as a partial failure of the jute crop, or a strike in the jute mills, focussed public opinion upon the necessity and desirability of a change in our methods of handling and transporting the major crop of Western Australia, as well as of the Commonwealth.

The record low price now obtaining for wheat, and the necessity for exploring every possible avenue for reducing wheat production costs, consequent upon the desperate plight of the farmer, now provides an essential reason for a reconsideration of the bulk handling question. In consequence, I feel the originators

WHEAT HARVESTING METHODS ON THE PACIFIC COAST, U.S.A.

As in Western Australia, the grain is harvested directly from the ripe standing crop.



At present only forty per cent. of the grain handled in bulk on the farm.

Sixty per cent. of the grain is still handled in bags on the farm, but 97 per cent. of the total exports are in bulk.

of the proposed scheme for Western Australia are entitled to gratitude for introducing it.

Unfortunately, its introduction, so late in the season, demanding a quick and possibly a hasty decision on a momentous problem of considerable financial magnitude, coupled with the proposal for an acquiring monopoly, which has been construed to mean a marketing monopoly, has led to heated opposition from some quarters. In consequence, the question of bulk handling is not likely to be discussed solely from the viewpoint of its advantages and disadvantages, but rather from a prejudicial standpoint, because of its association with a system of special design, or with projects or policies with which the producers, or even ardent advocates of bulk handling, may not be in accord. This is decidedly undesirable, and a plea is now being made that this matter be discussed dispassionately and as seriously as its importance demands, and having regard only to the one fundamental question that matters—Will it reduce the costs of production and transportation?

Very many estimates have been made to answer this question, but it is not easy to obtain definite information as to actual costs under both systems of handling grain under similar conditions for each. In New South Wales, where both systems have been practised under Australian conditions for several years, comparisons are difficult and complicated by the fact that it was introduced as an emergency storage scheme, and it is generally believed that the capital expenditure involved in connection with the extension of the scheme was unnecessarily high. The scheme is also considered to be somewhat unbalanced.

Some interesting information on the relative costs of handling wheat in bulk and in bags is furnished by a bulletin to hand within the past week from the United States Department of Agriculture; it is entitled "Bulk and Sack Handling of Grain in the Pacific Coast States," and its authors are Messrs. E. N. Bates, Senior Marketing Specialist, and G. P. Bodnar, Associate Marketing Specialist, Grain Division, Bureau of Agricultural Economics, U.S.A., and E. J. Stirniman, formerly Associate Agricultural Engineer, University of California. This bulletin is most valuable, as it is purely an economic study and the investigators are detached from the States concerned and likely to obtain a proper perspective of the position.

The information in the bulletin is of special interest to Western Australia, because the history of wheat development in the States referred to, and the methods of harvesting, are practically identical with those of our own State. The similarity between the history of their wheat belt and ours may be judged from the following opening extract from the bulletin:—"The origin and development of the grain producing and marketing industry on the Pacific coast is an interesting story of industrial growth beginning with pioneer conditions and developing into grain production in mammoth proportions, and then gradually giving way to other forms of agriculture as the country developed. When the rush for gold subsided somewhat, thinking men recognised that the agricultural resources of the new country far exceeded its mineral deposits. In the seventies the remarkable discovery was made that by a new method known as dry-land farming phenomenal yields of grain could be produced on the broad, dry inland prairies East of the coast mountains. These great plains were rapidly developed into vast wheat fields. The production of wheat soon exceeded the needs of the Pacific coast population. The wheat export business naturally developed to provide a market for the surplus grain. Conditions in those early days seemed to favour, if not to necessitate, the use of sacks for transporting Pacific coast grain. But changing conditions bring changing needs. The usual absence of rain in

the grain sections of the Pacific coast made it possible to leave grain in bags in the fields and in piles at country shipping points for months after the harvest, unprotected by roofs or covering. In the early days there were few railroads. Much of the grain was moved in wagons over poor roads to river banks and there loaded on barges for movement to deep-water terminals. There were no grain elevators; therefore, the simplest means of moving the grain was to put it in bags. Grain in bags accommodated itself to almost any form of transportation whether on land or water. Sailing vessels preferred grain in bags for the long voyage around the Horn. In fact, underwriters refused to insure sailing vessels or their cargoes if the grain was in bulk. The use of grain bags was, therefore, of natural growth, and the system became thoroughly entrenched. Conditions that encouraged or necessitated the use of sacks for grain have changed with the years. The size, motive power, and facilities of ships are now favourable to the handling of bulk grain. The Panama Canal has shortened the voyage from the Pacific coast to Europe, and no longer do insurance companies favour grain in bags. This is evidenced by the fact that the wheat exports from the Pacific coast are practically all in bulk at the present time (1930). In the keen competition on the world wheat markets the great factor for success must be *lowered production costs*. Producers on the Pacific coast are in a position to reduce their production costs by handling their grain in bulk from the threshing machine to the terminal markets. Many of the efficient farm managers have been among the first to recognise the possibility of handling their grain more easily, rapidly, and cheaply by the use of the bulk system. The high price of sacks and the high cost of labour during the World War stimulated a strong movement in the Pacific Coast States toward bulk grain on the farms. High construction costs during and after the war, the fact that grain dealers paid differentials in favour of sacked grain, the reduction in the cost of sacks and in the cost of labour after the war, and the sudden fall of the price of grain, retarded construction of country elevators for a time. Construction of terminal elevators for handling grain in bulk at export points, which was stimulated by war conditions, has been continued. The progress that the bulk method of handling grain has made in the Pacific Coast States during the last 10 years is based largely on this terminal elevator construction, which now makes bulk shipments from the country possible."

With the exception of the reference to water transport, it is the history of Western Australia over again. Even the production of wheat is nearly the same; in 1927/28 it reached 44½ million bushels, but in 1929/30 it dropped to 28 millions.

It is pointed out that the facilities for bulk handling having been provided, the quantity of bulk grain exported from Columbia River Markets to foreign countries increased from 1.4 per cent. to 97.3 per cent. of the total exports from those markets during the four-year period 1921-1925, and that in five-year periods since then to 1929/30 the bulk grain exports have not been less than that percentage, and this despite the fact that the receipts in bulk from the farmers have not in any year reached 40 per cent. of the total receipts from them.

It will thus be seen from the experience of these Pacific States that, though it may be desirable, it is not essential for the success of bulk handling for the whole of the crop to be handled in bulk, nor is there any evidence of the need for a monopoly for acquiring wheat. Bulk handling can, therefore, be carried out successfully quite apart from these two features.

Though it is not stated yet, as less than 40 per cent. of the receipts are received in bulk, and more than 97 per cent. exported in bulk, it is apparent that the largest

proportion of the wheat received at the terminals is emptied out of bags and shipped in bulk. This seems to indicate that this practice is due to the influence of one or both of the following factors:—

(a) The ease and cheapness of handling in bulk; and

(b) A preference of buyers for bulk wheat.

The investigators discuss first the saving effected on the farm through bulk handling. In this connection the Pacific coast farmer, like the Australian one, enjoys the benefit of a climate which enables him to allow the grain to ripen on the stalk, and then harvest it and thus dispense with the old world methods of reaping and threshing. One of the machines which the Pacific Coast farmer uses is somewhat different from our harvester or header. It is called the "Combine" (short for combined harvester); it is capable of taking a swathe of 20 feet and can deliver the grain either in bags or into a bulk wagon with and alongside the "harvester." The saving from farm to siding is discussed as follows: "Studies conducted on approximately 45,000 acres of grain land in California in the harvesting seasons of 1923 and 1924 indicate a lower labour cost for harvesting and hauling grain on the farm in bulk. Thirteen studies made on combines using the bulk method show an average labour cost for harvesting of $0.58 per acre, the corresponding labour expenditure being 0.92 man-hour. Twenty-three studies of combines using the sack method show an average labour cost of $1.57 per acre, the corresponding labour expenditure being 2.24 man-hours. The saving at the harvester, made by using the bulk method, was $0.99 per acre or a saving of 1.32 man-hours per acre. The cost of labour for operating combines includes the wages and board of the crew. The crew on the large-sized bulk-handling combines consists of a tractor driver, header-operator, and separator tender. The crew for sack handling requires one to three additional men to jig (shake) and sew the sacks. The cost of sacks on these farms during the period of the investigation was approximately 14 cents. each, and twine for sewing sacks cost about 0.5 cents per sack. The cost of handling empty sacks and twine from the railroad to the farm and threshing machine, although not included in the preceding analysis, is an item of cost which should be mentioned as it amounts to about 3 cents per acre for 15-sack per acre yields. The custom (contract) rate for hauling bulk grain from combines varied, but was generally found to be approximately 50 cents per ton less than the rate for hauling grain in sacks. In some cases the rates for hauling bulk and sacked grain were the same. The saving per bushel, calculated from the above unit savings by using yield records of the California crop for the years 1923 to 1927 is shown in the table hereunder:—

Year.	Yield per acre.		Estimated saving in cost per acre for—					Saving per bushel.
	Bulk.	Sacks.	Sacks.	Twine.	Hauling.	Harvesting.	Total.	
	bus.	No.	dollars.	dollars.	dollars.	dollars.	dollars.	cents.
1923	21·6	9·60	1·34	0·048	0·324	0·99	2·702	12·51
1924	15·0	6·67	·93	·033	·225	·99	2·178	14·52
1925	19·0	8·44	1·18	·042	·285	·99	2·497	13·14
1926	18·4	8·18	1·15	·041	·276	·99	2·457	13·35
1927	16·8	7·47	1·05	·037	·252	·99	2·329	13·86
Average ...	18·16	8·07	1·13	·040	·272	·99	2·433	13·48

A sack of wheat is estimated to be 2·25 bushels.

When dealing with the savings after the grain leaves the farm it is stated—"The saving resulting from the bulk method of handling grain is not confined to the farm. Every marketing operation that involves the handling of sacked grain is more expensive than it would be if the grain were handled in bulk. The marketing savings are not quite so apparent to the producer as are the farm savings, yet most of the marketing economies of the bulk system will probably be reflected to him eventually through reactions from competitive buying and co-operative marketing."

The investigators enumerate that there are ten ways in which savings can be effected from the country receiving point to ship's hold, and these, as well as the farm savings, are itemised in the following table in which all overhead charges (depreciation, redemption, etc.) are included in the rates given—

Item.	Cost per short ton (2,000lbs.) for marketing grain.		Saving by bulk method.
	In sack.	In bulk.	
	dollars.	dollars.	dollars.
Operation on farm—			
Labor on harvester	2·88	1·06	1·82
Hauling (contract rates estimated 50 cents a ton less for bulk grain)	...	...	·50
Sacks at 14 cents each, twine at 0·5 cents a sack ...	2·175	...	2·175
Operation from country shipping point to ships—			
Bad-order sacks and resacks	·069	...	·069
Sampling, weighing and grading grain	·06	·04	·02
Smutting charges for 0·5 to 1 per cent. smut dockage	·75	·45	·30
Freight on sacks	·023	...	·023
Loading cars at country points	·35	·15	·20
Unloading cars at terminals	·60	·40	·20
Resacking wheat after scouring to remove smut ...	·50	...	·50
Delivering grain to ship	·25	·10	·15
Weighing and inspection of export grain	·06	·04	·02
Stowing grain in ship	·50	·20	·30
Total	...	...	6·277
Summary of possible saving per ton and per bushel by bulk handling of—			
Smutty wheat:			
Saving per ton	...	...	6·277
Saving per bushel	...	...	·188
Saving per bushel after deducting discount of 3 cents per bushel on bulk wheat	...	...	·158
Smut-free wheat:			
Saving per ton	...	...	5·477
Saving per bushel	...	...	·164
Saving per bushel after deducting the discount of 3 cents per bushel on bulk wheat	...	...	·134

Here then are the conclusions of independent investigators, of men accustomed to deal with the economic side of marketing, who show that under conditions very similar to our own the transportation of wheat from farm to ship's hold in bags is more costly than its transportation in bulk. Australians pride themselves upon their efficient means of production. Evidently the methods of transportation are not equally efficient. In the present serious plight of the wheat industry is it economic to retain these inefficient methods, and how long can this waste represented by the difference between the cost of bulk and bag handling be continued to the advantage of our trade competitors?

The greater part of the f.a.q. wheat in this State is smut free, and, in consequence, from the State's standpoint it is only the savings connected with the handling of this type of wheat which need to be considered. On the Pacific coast these from the standing crop to the ship's hold were found to be 16.4 cents per bushel. Before accepting this sum as applying to this State the various items must be subjected to a critical examination. For instance, the saving of 5.46 cents per bushel in connection with the "labour on harvester" seems greater than could be saved under our conditions. A definite saving that would be effected is that now entailed in connection with the sewing, dumping and ramming of the bags; the contract rates for this range from 1d. (2 cents) to 2d. (4 cents) per bag, say, 3 cents, or 1 cent per bushel. It is, therefore, reasonable to assume that 1 cent would be saved: this involves a deduction of 4.46 cents.

It is not clear whether in this State there would be any appreciable difference in the cost of carting bulk and bagged wheat. In the extracts quoted the authors of the bulletin point out that in some cases the contract carting rate is the same for bulk wheat as for bagged wheat. It is, therefore, advisable to also deduct from the Pacific coast savings—the haulage saving of 50 cents per short ton (1.5 cents per bushel). With 3 bushel sacks at 7½d. each the cost in Western Australia for sacks is 2½d. (5 cents) per bushel, as compared with 6 cents on the Pacific coast; this involves a reduction of another cent. In New South Wales the difference in the rates paid for bagged and bulk wheat respectively ranges from 3d. to 6d. per quarter, or ¾ to 1½ cents per bushel in favour of bagged wheat, hence a further deduction of, say, another 1½ cents must be made.

Some exception may be taken to the charge for "grading" in the item "sampling, weighing and grading" in that, in the conventional sense wheat is not "graded" in Australia. When, however, our wheat is sampled and weighed at sidings or elsewhere, its value is also assessed and it is in this sense that the term "grading" has been used and its cost determined. This assessing or grading can be done more rapidly and more cheaply with bulk wheat than with bagged wheat, and the amount of the saving, viz., 2 cents per ton, is considered reasonable for this State.

In this State there is no general Government inspection of wheat for export. The item indicating this saving would, therefore, not be allowable for this State, and should be deleted. It involves a further deduction of .06 cents per bushel.

When the deductions specified are made the savings likely to be effected in Western Australia are set out hereunder:—

Saving per bushel on Pacific Coast		16.4 cents.
Less possible deductions for W.A.—		
Labour on harvester	4.46 cents.	
Haulage	1.50 „	
Sacks	1.00 „	
Weighing and Inspection	0.06 „	
Price difference in bulk wheat ..	1.50 „	
		8.52 cents.
		7.88 „

Thus a saving of nearly 8 cents or 4d. per bushel is indicated. Suppose, however, that contingencies, such as storage, etc., at present unforseen, would absorb about half this amount, and that the savings are possibly only 2d. per bushel, it will be

admitted the introduction of "bulk handling" is well worth while. Even if there are no savings I am in accord with the view of an economist friend of mine who writes—"Bulk handling of wheat would be a positive contribution to reviving prosperity if it can be organised and established at a cost showing a *net* increase in the farmer's share of the price obtained for his wheat, or even if merely substituted, without net loss, local jarrah and Australian galvanised iron for Indian cornsacks."

In bulk handling wheat is essentially "up by power and down by gravity," and, in consequence, manual labour is replaced by mechanical power. It is inconceivable to imagine that the adoption of bulk handling in the place of bag handling, by facilities in keeping with the volume of the crop to be handled, will not result in some reduction in costs. There must be savings. There *are* savings; our millers have proved this.

Can W.A. or, indeed, can Australia, afford to ignore the possibilities of them when so much depends upon reducing costs to save our main industry?

PRODUCERS' MARKETS CO-OPERATIVE, LIMITED.

Quarterly report for period ending 15th August, 1931:—

Fruit.—Supplies during the early part of the period were short. Windfall navels were heavily supplied with values very low. Lemons were also low, and other lines continued in demand. Towards the latter part of the period apples improved in value, but the quality for the greater part was poor, being very inferior and small fruit. Prime apples of 2½in. and 2¾in. grade in steady demand, but values for other lines low. Navels also improved, snipped navels selling to a firmer demand. Geraldton tomatoes also forward, realising satisfactory prices. Passion fruit and cape gooseberries short and in keen demand.

Vegetables.—Supplies of vegetables generally were lighter during the quarter; potatoes generally have shown little variation in value. Odd lines of choice samples of sandgrown winter crops have been offered, and these sold well at higher rates. A good demand exists at all times for lines of exceptional quality. Pumpkin supplies continued steady over the period, and values were on a level, except during the last few weeks when they firmed appreciably. A large quantity of inferior quality has been marketed this season, and it is difficult to find a market for this at any price at all. Buyers are favouring the "Queensland Blue" variety, especially those of medium size. "Trumble," of good colour, was also in better demand. Swedes increased in volume, but the demand held and values were firm for most of the time, but have been glutted during the last few weeks with lower values. Cabbage showed little change; supplies being maintained and values remaining steady for first quality. Cauliflowers were not so heavily supplied this year, and values for the most were good. Generally, we experience a glut of cauliflowers during this period, but from various causes this did not happen this year. Peas from the Geraldton district were on the market towards the end of June, but did not reach the high price that has been obtained in previous years. French beans from the same district made better values, but supplies were much lighter than previously. Both lines reach their peak during August, but as there is a big demand for them at current values, we should be able to handle the crop. Metropolitan gardeners cut out of celery in June, and the market was bare for about

a month until the York gardens started marketing. As is usual this line commanded high values, and some splendid quality was offered. Rhubarb firmed in value during the period, and supplies were maintained. The demand increased, and values firmed for all lines except turnips. Lettuce also showed an improvement, and prime lines sold well at all times.

Eggs.—During the month of May the supplies were still short of the demand, and as a consequence the price firmed from 1s. 11d. (ruling in the middle of the month) to 2s. 5d., values realised on 29th May. During the early part of June supplies increased, but the demand being keen the values remained firm on late sales. In the middle of the month there was a noticeable increase which sold at reduced rates to a weaker demand. Metropolitan new laid realised 1s. 3d. to 1s. 6d., country new-laid 1s. 1½d. to 1s. 2½d. The following week the low prices ruling seemed to have an effect on the public consumption, for although the supplies had increased still more than the previous week the demand was keen and greater than the supply, values advancing to 1s. 6d. and 1s. 6½d. for metropolitan new-laid and 1s. 6½d. and 1s. 7d. for new-laid country. For a few days supplies were still short, and sold to a keen demand with values slightly improved. Metropolitan new-laid realising 1s. 6d. and 1s. 9½d. On 1st July, although the demand was good, it could not cope with the large quantities being received from the metropolitan and country districts, and as a result values began to recede slightly; metropolitan new-laid 1s. 5d. to 1s. 7d. and new-laid country 1s. 3d. to 1s. 4½d. The early part of July showed a considerable increase in the supplies which sold to a fair demand, values being easier at 1s. 1½d. and 1s. 2d. for new-laid country. From 15th July onwards supplies increased, with the result that the supply was greater than the demand, and values receded to 9½d. and 11d. for metropolitan new-laid (specials 10½d. to 1s. 1d.), new-laid country 9½d. to 10d. Then prices receded still another penny, so the growers commenced packing for export on 28th July, and this had the effect of steadying the market, prices again advancing from 8d to 9½d. for metropolitan new-laid and 8d. to 8½d. for country new-laid to 11d. to 1s. 0½d. and 11d. to 11½d. respectively. That was the position at the 8th August, 1931.

Poultry.—During May the supplies were from fair to medium, with prime quality in demand. Turkeys were short supplied, with good prices ruling for good quality. Cockerels 6s. to 9s. Hens 5s. to 6s. 6d. Turkey gobblers 15s. 6d. to 21s. Turkey hens 10s. to 12s. 6d. During June all lines were heavily supplied with prime lines in demand, which maintained the rates mentioned above. Owing to the inclemency of the weather in July, supplies were shorter with values firmer throughout. Cockerels 8s. to 10s. 6d.; hens 6s. to 8s.; turkey gobblers 17s. 6d. to 20s.; turkey hens 11s. to 13s. Towards the end of the month of July supplies increased, with the firm values maintained.

Carcase meat.—During the quarter pork, veal, and beef were short supplied, with good inquiries for prime quality lamb. Hoggets and mutton have been fair to heavy consignments, which sold well to a good demand. Prices ruling:—Pork 5d. to 7d., veal 4½d. to 6d., lamb 4½d. to 6d., mutton 2¼d. to 4d., beef 3½d. to 5½.

LIVE STOCK AND MEAT.

For the information of readers of this "Journal," the following particulars have been supplied by Messrs. Elder, Smith, and Coy., Ltd., Perth.

COMPARATIVE NUMBERS OF STOCK SOLD AT METROPOLITAN FAT STOCK MARKETS, FOR MONTHS OF JUNE, JULY AND AUGUST, 1931.

	June.				July.					August.			
	3rd.	10th.	17th.	24th.	1st.	8th.	15th.	22nd.	29th.	5th.	11th.	19th.	26th.
Sheep	9,726	7,845	9,576	10,533	11,098	10,667	12,573	10,216	9,341	10,822	10,489	14,285	13,884
Cattle	540	486	498	655	695	678	676	574	592	486	503	451	670
Pigs	1,222	1,514	1,185	1,707	1,617	1,504	1,062	1,084	1,471	1,530	1,062	1,418	1,196

COMPARATIVE VALUES PER POUND.

	June.				July.					August.			
	3rd.	10th.	17th.	24th.	1st.	8th.	15th.	22nd.	29th.	5th.	11th.	19th.	26th.
	d.	d.	d.	d.	d.	d.	d.	d.	d.	d.	d.	d.	d.
Mutton ...	4½	4½	4½	4½	4½	4½	4½	4½	4½	4½	4½	4½	4½
Beef	5½	6	6	5½	4½	4½	3½	3½	3½	4½	4½	5	4½
Pork	7½	7½	7½	7½	7½	7½	7½	7½	7½	7	7	6½	6½
Bacon	5½	5½	5½	5½	5½	5½	5½	5½	5½	5½	5	5	5

MARKET REPORT.

Messrs. H. J. Wigmore & C., Ltd., of Wellington Street, Perth, have supplied us with the following information regarding Chaff offered at auction in the Perth Railway Yards, for the period June to August (inclusive). In all cases the price quoted is for f.a.q. to prime Wheaten Chaff, packed in new bags:—

	Quantity.	Maximum.	Minimum.
	Tons.	Per ton.	Per ton.
		£ s. d.	£ s. d.
June, 1931	805	4 7 6	4 0 0
July, 1931	790	4 7 6	4 0 0
August, 1931	995	4 7 6	4 0 0

The period under review has been very discouraging from a grower's standpoint; qualities under f.a.q. to prime have been very difficult to quit at low prices. During the months of June, July, and August there has been very little alteration in the price of f.a.q. to prime Wheaten Chaff. At the time of going to press the market remains steady for this quality at around £4 to £4 7s. 6d. per ton; f.a.q. at from £3 15s. to £4; medium qualities from £3 7s. 6d. to £3 10s. per ton.

Oaten Chaff.—During the past three months there has been practically no alteration in the prices ruling at auction. Prime quality has been selling at from £3 15s. to £3 17s. 6d.; f.a.q. at from £3 10s. to £3 12s. 6d.; medium qualities from £3 to £3 5s. per ton.

Oats.—Throughout the period under review the market remained steady. The closing quotations are as follow:—

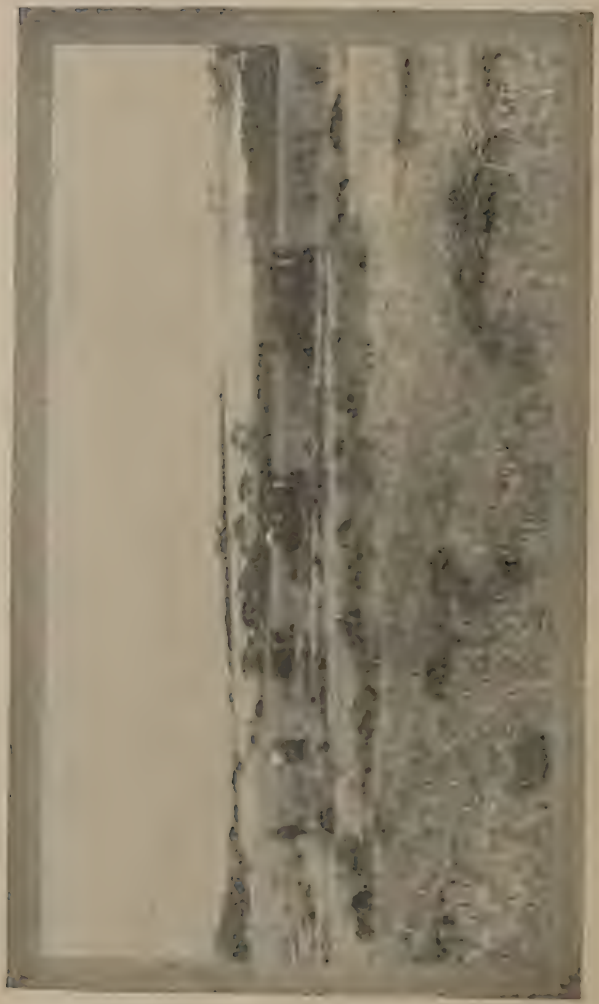
June, July, and August—

Good heavy feeds, 2s. to 2s. 2d. per bushel.

Good feeds, 1s. 9d. to 1s. 10d. per bushel.

Light feeds, 1s. 4d. to 1s. 6d. per bushel.

Wheat.—During June f.a.q. was selling at from 2s. 6d. to 2s. 8d.; second grade, from 2s. 3d. to 2s. 5d. per bushel; smutty samples, from 1s. 10d. to 2s. At the beginning of July the market for f.a.q. remained around 2s. 6d. to 2s. 7½d., but towards the end of that month the market eased to 2s. 3d.; second grade, from 2s. to 2s. 2d. per bushel. During August f.a.q. sold at from 2s. 3d. to 2s. 6d.; second grade, from 2s. to 2s. 2d.; smutty and inferior, from 1s. 11d. to 2s. per bushel.



METEOROLOGICAL INFORMATION.

STATIONS.	TEMPERATURE.				RAINFALL.		TEMPERATURE.				RAINFALL.		TEMPERATURE.				RAINFALL.	
	Maximum.		Minimum.		For Month.	Average.	Maximum.		Minimum.		For Month.	Average.	Maximum.		Minimum.		For Month.	Average.
	Mean.	Highest.	Mean.	Lowest.			Mean.	Highest.	Mean.	Lowest.			Mean.	Highest.	Mean.	Lowest.		
	JUNE, 1931.						JULY, 1931.						AUGUST, 1931.					
					inches.	inches.					inches.	inches.					inches.	inches.
Chapman State Farm	64·3	74·8	43·2	37·3	2·41	4·38	64·2	72·9	49·0	40·1	4·86	3·99	65·8	73·3	46·2	38·4	2·73	2·63
Geraldton	66·2	75·2	49·3	39·6	1·71	4·85	66·9	75·0	54·3	39·0	4·13	3·90	67·8	75·8	50·5	40·6	2·99	2·85
Walebing	60·0	70·5	38·7	31·0	2·34	4·07	59·7	66·2	45·3	32·8	5·37	3·74	...	...	...	...	...	3·03
Perth	60·8	70·7	44·8	37·2	6·54	7·04	62·4	69·1	50·2	39·4	7·90	6·70	63·7	71·2	48·3	38·1	6·84	5·71
Kalamunda	58·2	67·6	43·5	36·9	7·47	8·30	57·5	63·5	47·3	40·1	11·14	8·45	59·8	68·3	46·3	37·3	7·91	6·81
Bunbury	60·0	70·0	51·5	33·0	3·94	7·29	62·0	67·0	48·5	35·5	7·10	6·90	62·2	68·0	47·5	35·0	5·62	5·31
Bridgetown	59·0	69·8	35·6	25·8	4·86	5·90	60·1	66·0	43·3	31·0	5·05	5·80	61·4	69·8	41·0	31·0	6·36	5·06
Albany	59·2	66·3	44·6	35·0	3·88	5·47	59·6	68·8	47·9	41·0	9·29	5·55	61·5	73·0	46·8	40·8	7·56	5·16
Merredin State Farm	56·4	64·0	37·1	20·7	1·15	1·95	58·9	65·5	44·5	30·0	1·97	1·87	61·6	74·2	41·6	30·1	2·51	1·40
Northam	61·1	69·8	37·1	30·8	1·96	3·32	61·2	67·0	46·0	35·6	3·74	3·48	63·0	70·8	42·5	30·8	3·46	2·55
York	60·0	69·5	38·3	30·0	1·74	3·37	61·3	66·0	45·2	32·5	3·75	3·42	62·8	71·0	41·7	31·5	4·03	2·79
Narrogin State Farm	55·9	65·8	36·9	28·9	2·28	3·73	57·9	63·6	43·0	32·0	2·74	4·26	59·3	66·7	41·3	30·9	4·57	3·11
Katanning	56·0	65·1	38·5	28·3	1·90	2·96	57·6	63·0	44·6	34·0	2·76	3·08	59·6	69·1	44·5	35·3	3·39	2·44
Cape Leeuwin ...	59·7	66·0	50·6	45·0	5·43	6·90	59·7	64·2	52·2	47·2	7·86	7·28	...	...	...	...	...	5·24

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No. 30.—*Descriptive Account of the Codlin Moth.* L. J. Newman.
No. 37.—*Conference of Producers,* 1910 *and* 1912.
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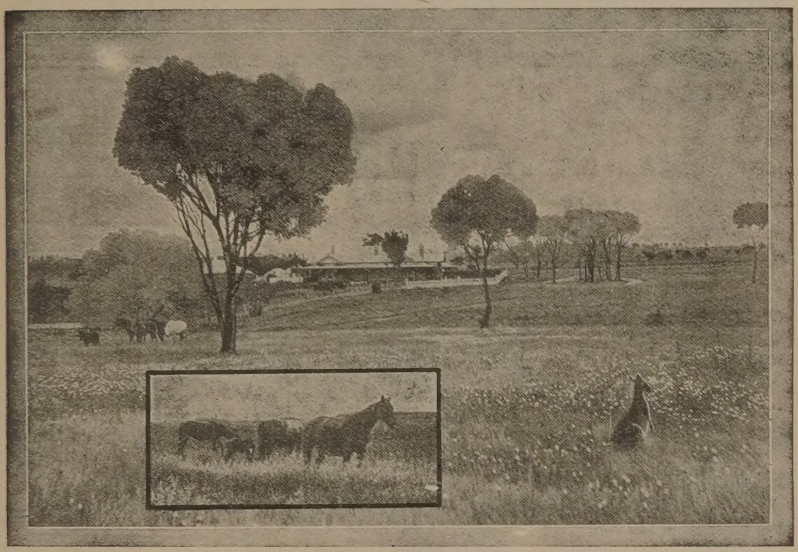

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